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ABSTRACT

This annotated bibliography of 247 entries is divided into the following categories: (a) general aspects and reviews; (b) sources of poisoning, epidemiology, and pica studies; (c) clinico-pathological studies; (d) diagnosis and screening; (e) laboratory methods; and (f) treatment and prevention. A subject and author index is included. (PD)

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POISONING AND INTOXICATION BY TRACE ELEMENTS IN CHILDREN

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an abstract review of the worldwide medical literature 1966-1971

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General aspects and reviews

1. Plumbism exists today—Reddick L.P., Bowman Gray Sch. of Med., Wake Forrest Univ., Winston-Salem, N.Car.—STH MED. J. (BGHAM, ALA.) 1971, 64/4 (446-450)

Although lead poisoning accounts for only a small proportion of cases of accidental poisoning, the high mortality associated with the condition makes it by far the most common cause of death due to accidental poisoning. Most cases of lead poisoning are due to pica in children who ingest old house paint from the structure and furniture of their housing. Less common sources reported include the application of an eye cosmetic containing lead sulphide to the eyelids and conjunctivae of a 3 year old boy and the swallowing of a lead button by a 2 year old child who subsequently died. In adults illegally distilled whisky, home brewed alcoholic drinks in lead-lined containers and soft or acid drinking water in lead pipes are important sources as well as industrial exposure. Smokers have slightly but consistently higher concentrations of serum lead than non-smokers due to lead arsenate spraying of the soil in which tobacco is grown.

2. Asymptomatic lead poisoning in 85 Chicago children. Some diagnostic, therapeutic, prognostic and sociologic considerations—Rennert O.M., Weiner P. and Madden J., Dept. of Ped., Univ. of Florida Coll. of Med., Gainesville, Fla.—CLIN. PEDIAT. 1970, 9/1 (9-13)

Eighty-five children with blood lead levels higher than 60 μg./100 ml. were found as the result of a door-to-door survey in high-risk neighborhoods of almost all children under 7 years. The children were aged from 11 months to 7 years with 35% being 2 years old. Ninety per cent of the children were asymptomatic but 10% had significant coproporphyrinuria and 6% had significant anemia. All patients were give a course of intramuscular chelation therapy with dimercaprol and EDTA. Those with blood lead levels greater than 150 μg./100 ml. were hospitalized for treatment. There were wide discrepancies between blood lead values reported by different laboratories. This posed a problem both in diagnosis and evaluation of the results of chelation therapy. Since none of the children had any symptoms before therapy, the overall effects of treatment were not clearly demonstrated. To eliminate childhood plumbism requires massive rebuilding of slums. However emotional factors may also be involved aside from the availability of paint chips and plaster. Usually only one child in a family, most often the youngest, is affected and it is possible that pica may be an indicator of emotional deprivation.

3. Lead poisoning in children – a disease of the environment—Roffman H. and Finberg L.—HLTH NEWS 1969, 46/7 (3-5)

The high risk of lead poisoning in children which exists in the ghetto districts of large cities has clearly been demonstrated. This risk mainly affects the children between the ages of 1 and 3 due to the pica common to 20-30% of children in this age group. The lead is absorbed and distributed in soluble form through the soft tissues and later deposited in the bone as an insoluble phosphate compound. The toxic effect of lead, which predominantly affects the nervous system, blood, kidneys and gastrointestinal tract, is produced by the soluble form and the amount of damage done therefore depends on the level of lead in the soft tissues, which may vary according to intake and mobilization from the bones. Seasonal variations, probably caused by variations in the absorption from the intestinal tract, have thus been observed. The symptomatology of lead poisoning may vary and individual symptoms produced also by other diseases. However, the diagnosis can be confirmed by determination of urinary coproporphyrin and δ-aminolevulinic acid of blood, blood and urinary levels of lead, morphological examination of red cells and X-rays of bones and abdomen. Two agents, which form a complex with soluble lead and thereby give rise to a precipitate excretion, are widely used in the treatment of lead poisoning. Lead poisoning is a recurrent disease by the nature of the social and economic conditions which foster its existence. Mass investigations with screening tests such as urinary coproporphyrin levels and blood levels, as well as the newer inexpensive techniques such as urinary δ-aminolevulinic acid determinations serve to detect and should ultimately eradicate this preventable disease.

4. Iron poisoning—J. AMER. MED. ASS. 1966, 198/12 (165-166)

Acute iron intoxication is one of the most common lethal childhood poisonings in the US. It almost invariably occurs in the pediatric age group, and the poison is usually in the form of ferrous sulfate tablets prescribed for a pregnant woman in the household of the poisoned child. Ingestion of as few as 10 to 15 5-grain tablets has been lethal. Typically, in the child who has ingested ferrous sulfate, symptoms develop within 30 to 90 minutes, with signs of shock, coma, acidosis, vomiting, diarrhea, and melena. The child may subsequently appear to improve somewhat, but within 10 to 14 hours further acidosis and coma, bleeding, and irreversible shock develop, and the child dies. Autopsy reveals no anatomic cause of death. The pathophysiology remains obscure. The iron chelater, deferoxamine, promises to reduce substantially the mortality of acute iron intoxication. It is most effective when given relatively early. Moreover, some question has arisen as to the occasional toxicity (principally hypotension) of deferoxamine or the iron-deferoxamine complex. A delineation of the mechanisms of iron toxicity is, therefore, considered important in order to improve the management and therapy of the poisoned individual, especially the patient who is not seen soon after iron ingestion, or in whom deferoxamine therapy fails. Animal experiments have shown that acute iron overload results in hyperventilation, profound acidosis with lactic and citric acidemia, and death. These findings suggest that a disturbance in oxidative metabolism is rapidly created by iron overload. Massive intravenous iron overloading of rabbits results in the development of hepatic necrosis. A study of the enzyme histochemical changes induced in the livers of acutely iron-overloaded rabbits has shown alterations in several enzymes involved in oxidative metabolism. Electron-microscopic studies of animals exposed to the same experimental procedures show early and severe mitochondrial injury, indicating that these organelles may be the site of the observed disturbances. The mechanism of this injury is not yet evident, but the experimental protocol provides a potential means of further acute iron poisoning.

5. More leads on lead—FD. COSMET. TOXICOL. 1967, 5 (414-418)

Lesions in chronic lead poisoning include kidney damage and cardiovascular disease. There is evidence that chronic lead poisoning during childhood can produce renal failure in later life. There is a significant increase in deaths from cardiovascular disease in retired lead workers which is related to vascular damage rather than hypertension. Blood hemoglobin levels are of little value in detecting incipient lead poisoning. Blood lead levels and urine excretion levels of δ-aminolevulinic acid (ALA) are the only valuable indicators of lead exposure. The cause of the anemia of lead poisoning is not known but it may be related to the effect of lead on the enzymes responsible for hemosynthesis and red cell glycolysis. Lead poisoning among storage battery workers has been found to be more common in those drinking more than 0.75 l. of strong liquor monthly. Children are particularly vulnerable to the domestic hazards of lead with paint presenting the most serious problems. Mental retardation and recurrent seizures are the most common long-term effects. A recent problem is environmental exposure to lead due to atmospheric pollution, water pollution and possibly also the high lead content of some fish from polluted water in small localized areas.

6. Prevention, diagnosis, and treatment of lead poisoning in childhood—Alpert J.J. et al.—PEDIATRICS 1969, 44/2 (291-298)

The causative factors in childhood lead poisoning include pica, which is often associated with difficulties in the relationship between the child and its mother, and poor housing conditions with window frames, plaster and walls painted with lead pigment paints. The biosynthesis of heme is very sensitive to the toxic effects of lead. This is the basis of one emergency test for lead poisoning - the qualitative detection of urinary coproporphyrin. Other emergency tests are X-rays of the abdomen to detect radiopaque material and X-rays of the wrists and knees for lead lines. Specific tests are estimation of whole blood and urine lead levels and the determination of δ-aminolevulinic acid in urine. Early diagnosis depends on early identification of the high-risk child since early symptoms and signs are non-specific. Treatment includes permanent separation of the child from his source of lead, chelation therapy with dimercaprol and EDTA and long-term after care. No child must ever be allowed to return to a leaded house.

7. On lead lines—Leone Jr A.J., Dept. of Radiol., Johns Hopkins Hosp., Baltimore, Md.—AMER. J. ROENTGENOL. 1968, 103/1 (165-167)

In lead poisoning in children at the time of initial calcification of the cartilage matrix there is in addition a laying down of lead in the same cartilage. The area of preference for lead deposition is the zone of calcified cartilage in the epiphysis. The next stage in normal epiphyseal plate growth would be osteoclastic resorption of the calcified and leadified cartilaginous trabeculae. The presence of lead in these trabeculae makes them resistant to resorption by the osteoclasts. The lead has no effect on osteoblasts and new bone is laid down on these persistent trabeculae. The result is an increase in the number and thickness of trabeculae at the metaphysis. Although lead is deposited here it is in very small amounts relative to calcium and it is the calcium that is principally responsible for the increased radiodensity.

8. Lead poisoning in children—Lin-Fu J.S., Div. of Hlth Serv., US Dept. of Hlth, Educ. and Welf., Bethesda, Md.—U.S. PUBL. HLTH SERV. PUBL. NO. 2108, 1970, 25 pages

The main cause of this condition is the ingestion of flakes of lead-containing paint from the walls and woodwork of dilapidated houses. Many cases are attributable to pica. The highest incidence is between 1 and 3 years with over 50% occurring in 2-year-olds. Mortality and morbidity are higher than is generally appreciated. From 1959 to 1961 lead poisoning accounted for 4.7% of 9853 cases of accidental childhood poisoning reported to the Chicago Board of Health, but it was the cause of 79% of the total deaths due to accidental poisoning in this period. A Chicago study of 425 children followed up for 6 months to 10 years after treatment for lead poisoning revealed that 39% had some form of neurological sequelae. The condition is often asymptomatic or manifested by symptoms commonly seen in other childhood illnesses. Confirmation of the condition requires a blood lead estimation. A level of 0.06 mg./100 ml. or higher is generally accepted as a positive finding. Treatment must not be delayed while waiting for full confirmation of the diagnosis. Prevention should be concentrated on the following: (1) education of doctors and other health workers many of whom are unaware of the extent and seriousness of the condition; (2) informing the public of the risks of paint ingestion in old houses and also of the danger from fumes produced by burning battery cases; (3) case finding programs; (4) follow-up of discharged cases and their siblings in view of the high rate of recurrence; (5) legislation directed at notification of cases, prohibition of use of paint containing lead for indoor use and removal of the danger from old housing.

9. Selected bibliography on lead poisoning in children—Lin-Fu J.S., US Dept. of Hlth, Educ. and Welf., Rockville, Md.—U.S. PUBL. HLTH SERV., NO. 72-5105, 1971, 30 pages

This bibliography covering the problem of childhood poisoning includes only literature published in English. Most of the papers are from the pediatric literature, but topics covered more thoroughly in relation to adults than children, *e.g.* metabolism, chronic renal complication, are also included. A limited number of papers on experiments in laboratory animals are cited.

10. Childhood lead poisoning ... an eradicable disease—Lin-Fu J.S., US Dept. of Hlth, Educ. and Welf., Soc. and Rehab. Serv., Child. Bur., Washington, D.C.—CHILDREN 1970, 17/1 (2-9)

Childhood lead poisoning is still epidemic in many US cities, despite full descriptions and knowledge of its prevention. It still takes a high toll among children, particularly Negros and Puerto Ricans. In 1960 there were 30.6 million houses in the US built in or before 1939, when lead paint had not been replaced by titanium in interior decoration. Until chelating agents were available, two-thirds of children with lead encephalopathy died. With dimercaprol combined with EDTA the mortality is less than 5%, but many of the survivors are left severely handicapped. Chronic renal lesions may lead to hypertension, gout and further mental impairment. Lower exposure to the poison may later result in chronic debilitation. Social, cultural and political factors are important in prevention. The mandatory use of lead-free paint for toys and furniture has not eliminated the problem, and routine medical checks are essential. The public and the courts should recognize that violations of housing codes are true crimes, as distinct from the 'social welfare offenses' which mainly carry only minimal penalties. Slum clearance should be accelerated, and here voluntary helpers have been active. It should be more widely known that the price of treating, to the age of 60, a person who incurs severe lead poisoning in childhood is about $220,000, whereas the cost of removing old lead paint from an average rowhouse is $250,300.

11. Undue absorption of lead among children - a new look at an old problem—Lin-Fu J.S.—NEW ENGL. J. MED. 1972, 286/13 (702-710)

The shifting of focus from treatment to prevention through early detection and termination of undue exposure has put childhood lead poisoning in its proper perspective. Many biological indices have been used to measure lead absorption and toxicity, but blood lead determination, even with its limitations, is generally accepted as the most valid and reliable indicator of recent excessive lead absorption. 'Normal' levels of blood lead have been the subject of varying assessments, but in general it may be stated that the mean blood lead level of the urban population without undue intake, expressed in micrograms per 100 ml., falls between the teens and lower twenties with an upper limit at or below 40 μg./100 ml., while that of children with few exceptions is somewhat higher. Large-scale screening programs in US cities have indicated that the problem of undue absorption of lead is enormous among young children living in old, dilapidated neighborhoods, as shown by figures from Chicago and New York City, where 20% or more of the children in the age group 1-6 years had blood lead levels of 40 or more μg./100 ml. Three to 6 months of fairly steady ingestion of lead generally precedes the development of lead poisoning in children and detection at this early stage and prompt termination of such ingestion will therefore prevent almost all cases of lead poisoning. Metabolic disturbances at low blood lead levels have been demonstrated *in vitro* and, although far from conclusive, findings have been reported which suggest that lead may cause serious damage, particularly to the nervous system in children who appear to be 'asymptomatic' and also that young children may be particularly vulnerable to the toxic effect of lead. Undue absorption of lead in children from deprived environments is therefore to be considered a health problem of alarming proportion, and early detection and termination of exposure are regarded as essential steps in the prevention of lead poisoning in children.

12. Two health problems: one solution—McLaughlin M.C.—BULL. N.Y. ACAD. MED. 1970, 46 (454-456)

In New York City there are 450,000 or more units of dilapidated housing in which old paint can be peeled off and eaten by toddlers. This paint was applied before lead-based interior paint was outlawed and can cause lead poisoning when ingested. A crash program of prevention and detection was instituted on a budget of $150,000 which was only sufficient to provide stop-gap measures. The City's Health Department has been working to overcome the difficulties involved in complex municipal administration - housing agencies, invisible and absentee landlords, court battles - and in the technical problems of removing and covering the dangerous paint. The Department is also working on the problem of interim rehousing and fostering to avoid sending a child back to the same conditions; but wherever possible keeping the child with his family. The development of a portable detection instrument has been of great assistance. It can detect as little as 1% of lead in old paint even under 10 coats of lead-free paint. It is to be hoped this problem will be tackled and solved with results as satisfactory as have been achieved by the recent anti-rubella vaccination program.

13. Lead and δ-aminolaevulinic acid dehydratase levels in mentally retarded children and in lead-poisoned suckling rats—Millar J.A., Cumming R.L.C., Battistini V., Carswell F. and Goldberg A., Med. Res. Counc. Res. Group in Iron and Porphyrin Metab., Univ. Dept. of Med., Western Infirm., Glasgow—LANCET 1970, 2 (695-698)

There has been controversy over an association between elevated blood-lead levels in children and mental deficiency. This study has revealed a negative correlation (r = -0.81) between blood-lead levels and δ-aminolevulinic acid dehydratase (ALA-dehydratase) activity in children. Significant decreases in enzyme activity occurred at lead levels considered to be in the upper range of normal (20-40 μg./100 ml.). When lead was fed to lactating rats there was a significant and commensurate reduction in both blood and brain ALA-dehydratase activity in the suckling rat. These results suggest that even modest elevations of blood-lead may be associated with biochemical abnormalities in the child brain.

14. Community aspects of childhood lead poisoning—Moore J.E.—AMER. J. PUBL. HLTH 1970, 60/8 (1430-1434)

The existence of lead poisoning in the US is one of the many manifestations of society's lack of concern for the impoverished and badly housed. Departments concerned with health and housing are often ineffectual because of compartmental alignments and poor liaison. Attempts to deal with housing which is unfit and in violation of local codes often end in court hearings resulting in inadequate penalties. Rehousing when it is effected is often undertaken without adequate screening of the unit which the family has been allocated. After more than 30 years of piecemeal and poorly financed housing programs, decent housing is still lacking for disadvantaged urban dwellers. Non-white families are the worst victims, 56% of them living in areas of substandard housing and urban blight. In discussing the social aspects of lead poisoning we must give first consideration to measures of detection and treatment and to immediate stop-gap measures. But we must not forget the larger social factors that are operating and by which underprivileged families are inescapably confined to poisoned housing.

15. Umbilical cord blood lead concentration. Relationship to urban or suburban residency during gestation—Scanlon J., Dept. of Neonat. Res., Boston Hosp. for Women, Boston, Mass.—AMER. J. DIS. CHILD. 1971, 121 (325-326)

No statistically significant relationship was shown for umbilical cord blood levels of lead and residency during gestation in either city or suburbs. The role of smoking cigarettes was also not significantly related. These values for cord blood lead are the first noted in the literature. If atmospheric contamination with lead continues at its present rate, further studies of cord blood lead concentration should be undertaken.

16. Lead poisoning - the silent epidemic—Rothschild E.O.—NEW ENGL. J. MED. 1970, 283/13 (704-705)

A review of the problem of lead poisoning in ghetto children is presented. This is a well known intoxication in the US, being associated almost exclusively with deteriorated housing, the defective walls, and woodwork of which provide a limitless source of ingestible old lead paint. The great bulk of affected children are poor and nonwhite. The charge of genocide by neglect has already been leveled against the health profession regarding this situation. This charge cannot be readily dismissed. The problem of lead poisoning in ghetto children will not be solved until a truly comprehensive family care is provided with an emphasis on preventive medicine for all citizens. Another problem mentioned is the potential hazard of lead poisoning from ceramic glazes. The question is raised of who has the responsibility to test and certify earthenware as safe for use with food.

17. Lead poisoning—Chisolm Jr J. J.—SCIENT. AMER. 1971, 224/2 (15-23)

It is possible that an amount of lead in the body insufficient to cause symptoms may nevertheless produce chronic adverse effects. There is evidence that lead waste has been accumulating in urban areas during the past century. Post mortem findings show a higher lead content in individuals from industrial societies than in those from primitive populations. There is a need therefore to try to control the dissemination of lead into the environment but a more pressing need is to control the exposure to lead of certain at-risk groups: young children from dilapidated houses where they can ingest pieces of lead paint, consumers of illicit (moonshine) whiskey, people who eat and drink from lead-glazed earthenware and workers in certain small industrial concerns where exposure to lead is not controlled. Some of the biochemical effects of lead have been biochemically investigated. One is the inhibitory effect on the enzymes which depend on the presence of sulfhydryl. This interferes with the biosynthesis of the iron-containing substance heme which, combined with protein, forms hemoglobin. Lead inhibits at least 2 of the 6 steps in the synthetic pathway. This results in the accumulation of coproporphyrin in the urine and red cells, and use can be made of this as a presymptomatic diagnostic test. The toxic effects of lead on the CNS are not fully understood. Two mechanisms seem to be at work: increased capillary permeability leading to edema, and a direct effect on the structure and functions of the brain cells.

18. History and epidemiology of lead poisoning—Ascher S.F., Office of Prod. Safety, US Food and Drug Admin., New York, N.Y.—PUBL. HLTH NEWS 1970, 51/7 (151-152)

Lead poisoning in children has come to be recognized over the last 40 years for the insidious disease resulting almost exclusively from ingestion of flaking and peeling lead containing paints in old dilapidated housing and on old furniture. Historically, the 4 major factors contributing to childhood lead poisoning were not interrelated in the traditional epidemiological approach. Dilapidated housing, lack of awareness of the problem among physicians and other health workers, lack of information on the part of the public, and lack of or inadequate prevention of reexposure to lead all worked together to perpetuate the problem. High risk areas for lead poisoning are almost synonymous with the slums or lead belts, where old, deteriorating housing prevails. Over 50% of all deaths from lead poisoning occur in 2 year olds. Some epidemiological facts pertaining to childhood lead poisoning are discussed.

19. Lead poisoning—Barltrop D., St Mary's Hosp. Med. Sch., London—ARCH. DIS. CHILDH. 1971, 46 (233-235)

British pediatricians diagnose fewer cases of lead poisoning, compared with the Americans. In England it has been suggested that 200 to 2000 cases were diagnosed per year. Wrist-drop and the Burtonian gingival blue line seldom if ever occur in children. Those affected tend to be 1-5 years old, have anorexia, irritability, anemia and later convulsions. Lead hazards are numerous, apart from defective housepaint. Metallic lead was found in an intragastric foreign body, lead nipple shields were used for nursing mothers, fall-out from factories can be toxic, and lead-glazed pottery is potentially dangerous. Burning-battery cases may cause inhalation of toxic amounts of lead. Lead is a cumulative poison and the ingestion of paint flakes containing 1-2 mg. lead may continue for 5-6 months before symptoms occur. X-ray changes may take 3 months to develop. Profound disturbances in the alpha/beta globulin synthesis were recently noted. The domestic environment should be screened to detect lead if an improvement is to be made.

20. Lead poisoning—Barltrop D., St Mary's Hosp. Med. Sch., London—J. HOSP. MED. 1969, 2/9 (1567-1573)

Lead is a widely distributed contaminant of air, water and foodstuffs, so that most adults have a daily intake of about 0.3 mg. Domestic water may contain lead dissolved from pipes; and children, particularly those with pica, may obtain lead from painted surfaces. Lead is a cumulative poison and its effects usually result from repeated ingestion of very small quantities over a long period. Ingestion of lead causes an immediate rise in the lead content of the soft tissues for which it has a special affinity, such as the erythrocytes, liver and kidneys. Ultimately, the soft tissue lead is transferred to the skeleton. The metabolic processes blocked by lead are still imperfectly understood but they depend on interference by lead with enzyme-controlled processes. The symptoms of lead poisoning are non-specific. The early manifestations include pallor, constipation, lassitude and anorexia. Generalized intestinal colic is also an early feature and muscular spasm occurs in adults. In more severe cases there are headaches and irritability, associated with vomiting and ketosis. In the late stages consciousness is impaired and convulsions and bulbar involvement precede death. The only characteristic physical sign is Burton's blue line at the gingival margin. Stippled pigmentation of the retina has been reported but is not generally accepted as a reliable sign. Children have few symptoms other than pallor or irritability before the onset of encephalopathy. Diagnostic tests include testing for microcytic hypochromic anemia. A blood-film should be examined for basophil stippling of the erythrocytes. Urine tests will show interference with renal tubular absorptive function and an excess of normal metabolites such as the porphyrin precursors. In children with pica, lead-containing paint flakes in the bowel may be detectable by X-rays. Treatment consists of removal from the source of lead and chelation with one or more of the 3 drugs: penicillamine, EDTA and dimercaprol. Severe cases bordering on encephalopathy should receive immediate treatment with paraldehyde and phenobarbital to control the seizures and with dexamethasone or intravenous hypertonic solutions of dextrose or urea to limit the cerebral edema. The deposition of lead in bone cannot yet be enhanced, and giving calcium and vitamin D is likely to do more harm than good. The prognosis depends on the presence of encephalopathy. Deaths from this cause are commoner in children than adults, and a mortality of up to 24% has been reported in children. Neurological damage is likely to be permanent, and survivors from lead poisoning may show an increased liability to chronic nephritis.

21. Lead poisoning in childhood—Barltrop D., Paed. Unit, St Mary's Hosp. Med. Sch., London—POSTGRAD. MED. J. 1968, 44/513 (537-548)

The prevalence of lead poisoning in children has yet to be determined because only severe cases are recognized. Since lead poisoning may cause cerebral damage and death it is important that children exposed to lead should be identified and if necessary treated. The most common source is flaking paint in old dwellings, and lead poisoning is commonly associated with pica. Children about 2 years old are chiefly affected. There are no symptoms up to a blood level of about 60 g./100 g., but above that there may be irritability, anorexia and vomiting, constipation, pallor, and coproporphyrinuria. When the blood level is over 80 µg./100 g. there may be impaired consciousness, with convulsions, coma and vomiting. The CSF protein and pressure are raised. Cessation of exposure and active treatment may reverse the progress but encephalopathy cannot always be prevented. The most reliable test for lead poisoning is determination of the blood-lead level. Values above 36 µg./100 g. are abnormal. Fecal lead is indicative only of current lead ingestion and determinations of urinary lead have no advantage over those of blood lead. Abnormal amounts of soft-tissue lead may be inferred from abnormalities of porphyrin metabolism. The reabsorptive mechanisms of the renal tubules are impaired in lead poisoning and glycosuria with a normal blood sugar is suggestive. Radiology is of only limited value in detecting ingested lead paint. As soon as lead poisoning is diagnosed, the affected child should be removed from the source of the lead. Unabsorbed lead in the intestine is removed by a saline purge. Oral EDTA should not be given as it may enhance absorption of lead from the intestine and precipitate encephalopathy. The 3 drugs used to remove soft-tissue lead are: EDTA (calcium versenate) administered as calcium disodium chelate, D-penicillamine hydrochloride, which may be given simultaneously with EDTA, and dimercaprol. Treatment is usually continued for 2-6 weeks. The possible value of a high calcium diet to increase the deposition of lead in bone has not yet been confirmed. It is agreed that vitamin D and agents to promote bone reabsorption, such as parathormone, should not be given. When lead encephalopathy occurs the treatment is to control the cerebral edema with 1.0 mg. of dexamethasone per kg. bodyweight daily intravenously, restrict the fluid intake to maintenance levels for 24 hours, and give dehydrating agents, such as 1 g. of 30% urea or 2 g. of mannitol per kg. bodyweight. Surgical decompression has been attended by a high mortality and is not recommended. The prognosis for children with encephalopathy is poor. Permanent cerebral damage is a common sequel to lead poisoning, 30% of the survivors being affected.

22. Disturbances of metabolic regulation in acute intermittent porphyria and lead poisoning / Regulationsstörungen bei akuter intermittierender Porphyrie und Bleivergiftung—G[illegible]ky L. and Roth I., Zentrallab., MAV Krankenh., Budapest—Z. KLIN. CHEM. KLIN. BIO-CHEM. 1969, 7/4 (333-338)

The symptoms of acute intermittent porphyria and lead poisoning were compared and found to be similar. In disturbances of porphyrin metabolism there is evidence of enzyme induction or enzyme inhibition. In both cases, however, the clinical diagnosis is based on an increase of metabolites. In lead poisoning, practically every stage of heme synthesis is affected. Too little attention is paid to the increase of uroporphyrinogen observed by Brugsch in lead poisoning; the urinary porphobilinogen value remains normal. Uroporphyrin is not formed in the urine during storage. In both conditions there are disturbances in the mineral and water balance. This is due to an increased secretion of antidiuretic hormone. There is also an increased secretion of melanophoric, somatotropic and thyrotropic hormones by the hypophysis. The increased secretion of hormones by the hypophysis is correlated with anatomical changes in the hypothalamus, which can be demonstrated both in porphyric patients and in experimental animals.

23. Lead absorption in children—Gordon N., King E. and Mackay R.I., Serv. for the Handicapped Child, Roy. Manchester Child. Hosp., Manchester—BRIT. MED. J. 1967, 2 (480-482)

It has been claimed that a raised blood-lead level is a common finding among mentally retarded children and that this is of etiological significance. 123 mentally handicapped children of uncertain etiology, 24 with mongolism, and 73 controls have been examined for lead intoxication. The results indicate that the 3 groups do not differ significantly as regards blood lead levels and no definite evidence of either acute or chronic lead poisoning has been obtained. This study does not suggest that these mentally backward children have been particularly at risk from lead poisoning, and emphasizes the limited value of an isolated estimation of the blood lead level. These conclusions do not depend on whether 36 or 50 μg. of lead per 100 ml. of blood is regarded as the upper limit of normal. However, if a value is found which is above the accepted level for the population in a particular area, this is an indication for further investigation, but not necessarily for treatment.

24. Lead poisoning as a disorder of heme synthesis—Goldberg A., Univ. Dept. of Med., Gardiner Inst., Western Infirm., Glasgow—SEMIN. HEMAT. 1968, 5/4 (424-433)

Despite their diverse etiology, lead poisoning bears some clinical similarity to acute intermittent porphyria, both producing abdominal pain, constipation and vomiting. Abdominal rigidity is more common in lead poisoning, and neuropsychiatric manifestations in acute porphyria. Paresthesia occurs in both. Epilepsy is more common in porphyria but has been observed in lead poisoning. Cardiovascular anomalies may be associated with porphyria and also with lead poisoning, but whereas 94% of patients with lead poisoning were found to be anemic, anemia was found in only one patient with acute intermittent porphyria. The cause of the anemia in lead poisoning is probably a combination of hemolysis and direct inhibition of hemoglobin formation. The main clinical effect of both lead poisoning and acute porphyria is on the nervous system. There is demyelination and axon degeneration and the diseases cause similar damage to the anterior horn cells of the spinal cord and the medulla. Porphyria and inorganic lead poisoning both cause changes in the urinary and blood porphyrins, but in organic lead poisoning the urinary excretion of aminolevulinic acid (ALA) and the protoporphyrin content of the erythrocytes are normal. In children, as distinct from adults, with lead poisoning, there is a poor correlation between moderate levels of blood lead and urinary excretion of coproporphyrin and ALA. The correlation is better between blood lead and raised erythrocyte protoporphyrin levels. A block at the stage of the incorporation of iron into protoporphyrin inhibits the formation of heme, causing an accumulation of porphyrin and porphyrin precursors. There is also evidence of an inhibition of ALA dehydrase in the erythrocytes and of heme synthetase in bone-marrow erythroid cells. The neurological complications of lead poisoning may apparently be caused by the direct action of lead on the nervous system. This would explain most of the clinical signs, but not the anemia which results from the action of lead on the bone-marrow. The abnormalities of porphyrin metabolism in human lead poisoning are similar to those produced in experimental animals. In porphyria, however, the clinical neurological manifestations found in man have not been reproduced in animals. In acute intermittent porphyria there is no evidence of a disorder of heme synthesis in the nervous system, and the defects in the brain and nervous system seem to be only indirectly associated with the disorder of pyrrole pigment metabolism in the liver.

25. A short history of Minamata disease research and the present situation of mercury pollution in Japan—Ui J., Dept. of Sanit. Engin., Univ. of Tokyo—NORD. HYG. TIDSKR. 1969, 50/2 (139-146)

The Minamata disease is a severe intoxication of the central nervous system caused by low molecular normal alkyl mercury compound in fish and shellfish. It was discovered in 1956 by Dr. Hosokawa, Director of the Minamata Factory Hospital. The first case had appeared in 1953 and by 1956 the disease had reached epidemic proportions in patients who had been eating large quantities of fish from Minamata Bay. In most of a group of 41 patients, movement and speech were impaired, about half were affected in sensation and vision, and a fifth suffered difficulties in hearing and swallowing. Mental disturbances occurred in 20%, convulsions in 14%, paralysis in 12%, salivation troubles in 10%, and muscular rigidity in 10%. Methyl mercury was discovered in the factory waste and in 1965 there was a second outbreak of the disease in villages along the Anago river, arising from waste discharged from a factory using an acetaldehyde synthesis process. Phenyl mercury compounds used as fungicides in rice fields have also been a source of pollution and their use has been stopped. The author considers that unpolluted fish from rivers in Japan have a mercury concentration of about 0.02 mg./kg. and that values above 0.1 mg./kg. indicate pollution. Various factors, however, have to be considered, including the species of fish, ecological conditions, food-chains, the quantity of the water flow, and the discharge of synthetic substances in waste. These may account for pollution values being much lower in Japan than in Sweden, where methyl mercury pollution has also been reported.

26. Lead poisoning remains health hazard—Waite R.—J. ENVIRONM. HLTH 1968, 31/3 (274-275)

Lead has 2 properties which contribute to its wide usage: it does not readily oxidize and it has a low melting point, making it easily fashioned into dishes and utensils. The Romans already used it in their aqueducts. In the 16th and 17th centuries the toxicity of lead was recognized and its use forbidden. But in the US the control of lead was only established after about 1920. In 1965, 1 billion tons of lead were processed in the US. The principal uses are automobile batteries, petroleum industry, in manufacture of anti-knock gasoline, and manufacture of paints. Lead is absorbed in the human body by ingestion (pica), inhalation of fume or dust (shipbreakers, miners) and skin absorption (painters, battery-workers). The gastrointestinal absorption of lead is enhanced by high intake of vitamin D, the amount of absorption is in the order of 1-5%. Cattle may eat greasy residue carelessly dumped by service stations. Waterfowl may ingest pellets from hunters' shot guns in heavy hunting areas. The toxicity of lead to animals and man poses a health problem, especially with the growing use of leaded gasoline. There is no immediate danger for the general population, but smoking city dwellers, a police officer directing traffic and a garage mechanic are examples of those exposed to greater amounts of lead.

27. **Acrodynia - postmortem of a disease**—Warkany J., Child. Hosp. Res. Found., Cincinnati, Ohio—AMER. J. DIS. CHILD. 1966, 112 (147-156)

This article reviews the history of acrodynia (pink disease) in children, its early description, international incidence, causation and gradual virtual elimination. A detailed description given in 1920 is compared with the known, though unrecognized because unsuspected, picture of mercury poisoning. Affected children had taken mercury in calomel ('mild' mercurous chloride) as a laxative, in anthelmintics, and for any febrile disease; unknown ingestion of mercury in teething powders, from ammoniated mercury ointment, and bichloride of mercury as a diaper rinse, also occurred and made establishment of cause and effect difficult. Accidental exposure to sealing wax (mercuric sulfide), felt hats, batteries and several other miscellaneous articles also explains why history did not always indicate ingestion of mercury. Laboratory determination of urinary mercury however cleared up some of the confusion. However, acrodynia only occurs in a small minority of children exposed to mercury, and the adverse reaction may occur months after exposure when mercury that has been stored in a harmless insoluble form becomes, for some unknown reason, soluble and toxic. Eradication of mercury from teething powders and worm medicines, either by compulsion or by voluntary action, has almost eliminated acrodynia.

28. **Acute and chronic childhood lead poisoning**—Wehrle P.F. et al.—PEDIATRICS 1971, 47/5 (950-951)

According to this report virtually all cases of childhood lead poisoning occur in children who live in old, deteriorated houses built and painted when the use of lead-based paints on housing surfaces was widespread. Eighty-five per cent of recognized cases occur in children in the 1- to 3-year age range in which pica is prevalent. Consequently, the disease results from the interaction between hazardous housing and the child with pica. Early diagnosis of plumbism on clinical grounds alone is exceedingly difficult, and often impossible. Furthermore, by the time the clinical diagnosis is obvious, permanent brain damage which cannot be modified by therapy may already have taken place. Surveys have revealed that 10 to 25% of young children who live in deteriorated urban slum housing show evidence of increased absorption of lead and that 2 to 5% show evidence of poisoning. While recent therapeutic advances have reduced the mortality of acute lead encephalopathy, it is now apparent that at least one-third of the survivors of encephalopathy sustain permant irreversible damage to the brain. Significant reduction in the risk of permanent brain damage, therefore, requires identification of the child with increased body lead burden prior to the onset of poisoning. The following recommendations have been made: (1) The major emphasis of programs designed to prevent adverse health effects in children from lead be placed on the testing of dwellings for lead-pigment paints on housing surfaces, both interior and exterior, in order to identify high-risk areas within the community. (2) As a policy, determine lead in blood of all 12- to 15-month-old children living in poorly maintained dwellings in identified high-risk areas and wherever other special local situations expose children to lead hazards. A subsequent sample of blood should be obtained during the following spring or summer. Those children with levels of blood lead greater than 50 μg./100 ml. whole blood should be referred immediately for definitive medical evaluation and a repeat blood lead determination. All children having 2 blood samples with a concentration greater than 50 µg./100 ml. whole blood should be reported to the responsible local government agency by appropriate officials and action taken to eliminate the hazard.

29. Epidemiological and experimental aspects of lead and mercury contamination of food—Clarkson T.W., Dept. of Radiat. Biol. and Biophys., Univ. of Rochester, Rochester, N.Y.—FD. COSMET. TOXICOL. 1971, 9 (229-243)

There is now an increasing release of lead and mercury into the environment, with increasing levels occurring in human food. The author discussed the ways in which heavy metals enter human food and the chemical state of heavy metals in food. Hitherto estimates of the allowable quantities have been assessed too crudely, with insufficient regard to the form taken by the metal. It has been found that the toxic effects of mercury differ according to its chemical form, and the rate of absorption in the gastrointestinal tract is influenced by it. In the normal population the average blood level of lead is considered to be 17 µg./100 ml., as compared with a no-effect level of 50-80 µg./100 ml. Most normal subjects have mercury blood levels below 4 µg./100 ml. and the no-effect level is believed to be 60 µg./100 ml. Data are not available for the no-effect level for chronic ingestion of lead but it is calculated as being 1-8 mg./day; the allowable daily intake should therefore not exceed 100-800 µg./day. The estimation of no-effect levels of mercury is even more difficult as the interaction of alkylmercury compounds with drugs is not known but the no-effect threshold may be about 0.7 mg./day. The antidotes proposed for heavy metal poisoning are mostly complexing or chelating agents. Dimercaprol and EDTA have been used for lead poisoning but EDTA is useless in mercury poisoning. Both dimercaprol and EDTA are ineffective in cases of alkylmercury poisoning, to which no antidote has yet been found. It has, however, been reported that D-penicillamine may be able to increase the excretion of mercury. Any antidote to alkylmercury would have to be given early to prevent damage to the central nervous system. More needs to be known about the mechanism of urinary and fecal excretion of heavy metals. Fecal excretion of mercury could be greatly increased if the rapid absorption of methylmercury-cysteine secreted in bile could be prevented, perhaps by oral doses of mercury-binding agents. Research is needed to increase the sensitivity of analytical methods, to find a sensitive biochemical test for mercury poisoning, and to find an antidote for alkylmercury poisoning.

30. Methyl mercury poisoning in fish and human beings—Eyl T.B.—MOD. MED. (MINNEAP.) 1970, 38/23 (127, 136-7, 141)

The relatively inoffensive metal is converted, before entering the algae-fish-human food chain, into methyl mercury. This biological methylation is accomplished by bacteria called *Methanobacterium omelanskii* living in the bottom mud. These bacteria are then eaten by plankton, which in turn are eaten by fish. The symptoms and signs of methyl mercury poisoning are briefly reviewed, as well as the possible fetal and genetic effects. The problems of pollution control are discussed.

31. Lead poisoning: biochemical lesions and biological semeiology / Le saturnisme: lésions biochimiques et séméiologie biologique—Delwaide P., Heusghem C. and Noirfalise A., Lab. de Chim. Méd, Toxicol. et Hyg., Univ. de Liège—ANN. BIOL. CLIN. 1968, 26/7-9 (987-1001)

The laboratory can give direct and indirect evidence of tissue impregnation by lead and diagnose early manifestations of toxicity in the hemopoietic organs. It is thus possible to make a diagnosis before any clinical manifestations of symptoms develop in chronic lead poisoning. Provided that it is thorough and that it is accurately discerned, the biochemical investigation is the basis for a diagnosis of lead poisoning.

32. Certain biological effects of lead upon the animal organism—De Bruin A., Coronel Lab. for Occupat. Med. and Environm. Hlth, Univ. of Amsterdam—ARCH. ENVIRONM. HLTH 1971, 23/4 (249-264)

In a comprehensive review of the scientific literature, all of the biological, for the most part biochemical, phenomena which are known to result from the absorption of lead in measurable quantities into the bodies of animals and men have been assembled. An attempt has been made to indicate the extent to which the quantitative measurement of certain of these reactions to the absorption of lead might be employed, or developed to the point of employment, in order to recognize the likelihood of the occurrence of clinical lead poisoning in time to prevent its occurrence. Of greater import is the demonstration of the multiplicity of effects which sufficient concentrations of lead may induce in the biochemistry and physiology of animals.

33. Lead poisoning: a preventable childhood disease of the slums—Oberle M.W.—SCIENCE 1969, 165 (991-992)

The classical signs and symptoms of lead poisoning include convulsions, vomiting, anemia, cramps and a high blood content of lead. Since the metal often accumulates slowly over a period of months a child may reach a dangerously high tissue concentration without showing any of the external signs. Since 1940 in the US leaded paint has been supplanted by titanium-dioxide-based paints and many authorities have banned the use of leaded paint for interior surfaces. However, the poorer areas of many cities have many old properties with peeling coats of leaded paint and it has been estimated that 5-10% of children between the ages of 1 and 6 years have an abnormally high content of lead in their blood. When a child is found to be suffering from lead poisoning he is usually treated in hospital with chelating agents, including dimercaprol and EDTA. It is estimated that early detection and treatment have reduced the mortality of severe lead poisoning from 66% to less than 5%. However, 25% of the survivors still suffer from brain damage. Also, after returning home the survivors often resume their paint-eating habits and if they have a second attack brain damage is almost certain to occur. Dissatisfaction with the apparent lack of concern about this danger on the part of the authorities has led to rent strikes and the formation of community action groups. Three bills proposing federal aid for testing programs and house decontamination have been submitted by 19 Congressmen but have received little support.

34. Lead poisoning—Danovitch S. and Gruver C.—MED. ANN. D.C. 1970, 39/10 (583-589)

In Washington, D.C. and other major metropolitan areas of the US lead poisoning in children is reaching near-epidemic proportions. A pilot screening of children between 18 months and 4 years showed that 8% had levels of 40 μg./100 ml. Children under 6 years living in poor housing are the most susceptible. Physicians are warned to be alert to symptoms of irritability, fatigue, central nervous-system dysfunction and neurological syndromes including convulsions, particularly if the child engages in pica and ingestion of paint. Lead concentrations of over 60 μg./100 ml. can be considered definitely abnormal, while 40-60 μg./100 ml. are borderline cases. Patients with over 100 μg./100 ml. may still be asymptomatic but are at risk of lead encephalopathy, with an attendant mortality of 5-10% and permanent chronic disability of 25-50%. Urinary δ-aminolevulinic acid

(ALA) concentrations in excess of 1 mg./100 ml. correlate well with blood lead concentrations in excess of 60 μg./100 ml. and with the presence of symptoms, and urinary ALA may therefore be used as a screening device when blood testing is not feasible. Other tests are not recommended as they are not sufficiently specific or sensitive. When a blood concentration of about 60 μg./100 ml. is found, chelation therapy with dimercaprol and/or EDTA should be promptly initiated, and the source of the intoxication removed. Cases in Washington, D.C., must now be reported to the Department of Public Health as a case of a notifiable disease.

35. Metabolism of aminoacetone and lead poisoning / Metabolismo dell'aminoacetone e intossicazione saturnina—Pisani W., Bonzanino A. and Lacquaniti A., Ist. di Clin. Med. e Ter. Gen., Univ. di Torino—MED. D. LAVORO 1967, 58/4 (279-285)

The metabolic cycle of aminoacetone, an aminoketone derived, as the δ-aminolevulinic acid (ALA), from the condensation of glycine with an acyl derivative, is described and the experiments are reported, by which such cycle could be suggested. The plasma level and the urinary excretion of the 2 aminoketones were determined by a technique of chromatographic separation, in subjects exposed to the risk, with clinical findings of lead poisoning. Both the blood level and the urinary excretion of the 2 aminoketones resulted to be increased, although much less than those of ALA. The hypothesis is suggested that such an increase might be due to an enzymatic blockage by lead on the oxidative deamination of aminoketones.

36. Lead poisoning in children—Standard R.L., Hlth Serv. Adm., Washington D.C.—MED. ANN. D.C. 1970, 39/7 (399-340)

In Washington D.C lead poisoning is now included in the health regulations as a reportable disease. It is also forbidden by law to use paint containing more than 1% lead on toys, furniture and interior surfaces of any dwelling. In 1968 there were 45 cases of plumbism diagnosed at Children's Hospital. It has been estimated that more than 500 children in Washington D.C. are stricken with lead poisoning each year and that about 5000 children have significant amounts of lead in their system. Lead poisoning seems to be related to 22,000 substandard dwellings in the city, which were painted with lead-base paint prior to World War II. A prevention program was begun with the screening of 900 children, aged 18 months to 4 years, in cooperation with the Health Service, the United Planning Organization and the Medical Committee for Human Rights. It was their intention to find and treat all children with lead poisoning.

37. Lead poisoning—Harrison H.E., Baltimore City Hosp., Baltimore, Md.—US PUBL. HLTH. SERV. NO. 1791 1968, (245-253)

In discussing lead poisoning in children, the author first summarizes the mechanism of its action, by interference with heme synthesis, and the significance of the raised blood-levels of porphyrin precursors. His studies with Chisolm indicate that slum children may swallow as much as 5-100 mg. of lead daily through chewing painted surfaces, which is far more than the intake from industrial exposure. The lead levels in the blood of healthy subjects under normal exposure at various ages are set out in a table. The median and range, in μg./100 g., at 0-6 months were 15 and 5-31; at from 6 months to 8 years they were 27 and 15-40; at from 4 months to 14 years they were 24 and 14-42; and in adults they were 27 and 15-40. There is a table of mortality-rates and the incidence of permanent neurologic residua, summarized from the literature, and another showing the relation between the incidence of severe CNS sequelae and re-exposure to lead after recovery from a first attack of acute lead encephalopathy. In children the disease is a chronic one with high lead levels in the soft tissues and a liability to acute exacerbations, mostly either in the summer as a result of exposure to the sun or following febrile infections. Measles has been an important precipitating cause in many of the acute attacks. Children with lead poisoning who are subjected to chronic exposure and have multiple acute exacerbations finally develop severe brain damage with serious mental deterioration. The treatment methods used included dimercaprol, CaEDTA and penicillamine.

38. Lead poisoning in children—Lin-Fu J.S., Div. of Hlth Serv., US Dept. of Hlth, Educ. and Welf., Washington, D.C.—US DEPT. OF HEW PUBL. NO. 452 1967, 25 pages

A review is presented of the incidence of lead poisoning in a number of US cities, covering mortality and morbidity, epidemiology, diagnosis and screening, and factors contributing to lead poisoning. The ways to control and prevention include: professional and public education, case finding, follow up of cases, legislative measures, research, and improved housing.

39. Clinical toxicology—Polson C.J. and Tattersall R.N.—J.B. LIPPINCOTT CO, PHILADELPHIA, PA. 1969, 655 pages

Poisoning from the domestic rather than the industrial standpoint is considered in this book on clinical toxicology. Part 1 deals with diagnosis, treatment, accidental poisoning in childhood and the doctor's procedure when poisoning is suspected and part 2 with individual poisons. In part 1 the diagnosis of lead poisoning is based on convulsions associated with the onset of coma, as possible symptom of lead encephalopathy; cerebral convulsions in adults may be produced by lead in addition to other poisons; peripheral muscular weakness, often associated with wasting and sometimes with gastrointestinal disturbances may possibly be due to lead poisoning. The chapter on lead in part 2 briefly reviews domestic lead poisoning and discusses this form of poisoning from the standpoint of incidence, absorption, distribution, excretion, normal intake of lead, the lethal dose, clinical manifestations, diagnosis, lead poisoning in children and treatment. Seventeen cases are reported

40. Drugs and poisons in relation to the developing nervous system. Proceedings of the conference on drugs and poisons as etiological agents in mental retardation—US PUBL. HLTH SERV. PUBL. NO. 1791 1968, 276 pages

The main subjects covered at the conference of drugs and poisons as etiological agents in mental retardation were: parameters of the developing nervous system, role of a regulatory agency, epidemiology approaches, and specific model systems. Although here the problem is known it is difficult to get improved action. Is it cheaper to let things go on happening at the cost of lead encephalopathy and its consequences than to do something about it? Even if a case of mental retardation were regarded as an accident, in the way that every aircraft crash is recognized as an accident, a better system of surveillance and investigations could be evolved.

41. Self-poisoning and accidental poisoning—Hyman S. and Greengard J., Cook County Hosp., Chicago, Ill.—POSTGRAD. MED. J. 1967, 41 (578-584)

A series of 468 cases of self-poisoning in teenagers and adults and 1645 cases of accidental poisoning in children are reviewed. The most common causes of poisoning in the teenagers and adults were barbiturates, aspirin and tranquillizers. In the children 35% of poisonings were due to medicines, 25% to corrosives, 22% to lead paint or plaster and the remainder to household chemicals. Poison control centers established under departments of public health can provide information concerning toxic ingredients in commercial products and medicaments. The physician is a key person in poisoning prevention, especially in the education of parents and in not prescribing excessive amounts of medication. Of 221 children with lead encephalopathy 61 (27%) died.

42. What is the status of knowledge of the toxic effect of lead on identifiable groups in the population?—Hardy H.L., Occupat. Med. Serv., Massachusetts Inst. of Technol., Cambridge, Mass—CLIN. PHARMACOL. THER. 1966, 7/6 (713-722)

The wrist-drop occurring in painters is the only specific symptom in lead poisoning. Lead affects many biological systems and chronic poisoning may alter cells at the molecular level. It has injurious effects on the germ cells of both sexes, and it has been used as an abortifacient agent. Enzyme systems in the brain may be disturbed in lead encephalopathy, and in acute cases, renal function can be impaired. Growing tissue is probably more vulnerable than adult tissue - accounting for the difficulty of diagnosis in industrial workers. The possibility of illness, indirectly caused by lead, should be carefully considered, *e.g.*, peptic ulceration and jaundice. Even cigarette smoking and alcohol may contribute to the hazard. Well-designed prospective studies of special populations are needed to safeguard the extra burden of lead in the air, water, soil and food.

43. Lead poisoning in childhood: signs, symptoms, current therapy, clinical expressions—Greengard J., Cook County Child. Hosp., Chicago, Ill.—CLIN. PEDIAT. 1966, 5 (269-276)

Early symptoms of lead poisoning are vague and non-specific and the physician sometimes fails to consider the possibility that they are caused by lead. Pica in children in slum housing is the most common case. Seasonal factors are of great importance in the overt manifestations of lead intoxication. Children with high blood lead concentrations may be Symptom-free in winter and develop serious disorder with the advent of warm, sunny weather. Basophilic stippling of erythrocytes is only seen in 30-40% of children with lead poisoning. The urine contains large excesses of coproporphyrin and δ-aminolevulinic acid. Tests for lead in blood and urine are time consuming and cannot be performed in most hospital laboratories. Blood lead levels are useful but urinary lead determinations are much less reliable. Radiology of the abdomen for radiopaque lead-containing plaster and of the bones for lead lines is valuable. The definitive clinical diagnosis of lead encephalopathy is based on spinal fluid findings but lumbar puncture itself may precipitate fatal complications due to release of fluid under increased pressure with herniation of the cerebellar tonsils or temporal lobes. Paraldehyde is a safe drug for the treatment of convulsions but if it proves ineffective a general anesthetic may be used. Chelation of lead with EDTA and dimercaprol in combination may be effective in encephalopathy and is of considerable importance in early cases. Respiratory arrest, anemia, gastrointestinal bleeding, shock and nephritis are frequent complications of lead intoxication. The problem of removal of the child from the source of lead is difficult, involving the cooperation of many agencies.

44. Varying psychological sequelae of lead ingestion in children—Wiener G., Div. of Matern. and Child Hlth, Dept. of Populat. and Fam. Hlth, Johns Hopkins Univ., Baltimore, Md.—PUBL. HLTH REP. 1970, 85/1 (19-24)

Pica is a predisposing factor to lead poisoning in children over 18 months of age and may therefore be a cause of mental retardation. Blood and urine tests for lead do not correlate perfectly with each other or with severe encephalopathy. The inner city metropolitan areas in the US termed the 'lead belt' are characterized by old and neglected dwellings with a poor, mainly Negro, population. Many of the older buildings have outside and inside paintwork containing lead pigments which may poison children with pica who chew it. In one study of low-income families in the US, mainly Negro, 33% of the 604 children under 5 years of age showed coproporphyrinuria, indicating chronic lead poisoning, and in another study of 333 children brought for medical examination, 44% had abnormally high blood-lead levels (over 0.05 mg./100 ml.). Age and duration of exposure to lead were the most critical factors. Young children may be neurologically affected by excessive lead absorption because their brain enzymes are poisoned during development, but in asymptomatic cases of lead poisoning there may be intellectual improvement. Of 10 cases surviving in 1964 who had had convulsions and had blood-lead levels over 0.04 mg./100 ml., only 2 had IQs over 90. All but 2 of the studies reviewed here reported some mental impairment in children with lead poisoning, but the controls were not rigid enough to prove that lead caused the changes. The necessity for controlling the subjects' sociocultural background, age, nutritional and emotional state, and intellectual level while varying the lead intake poses difficult research problems, and though animal experiment can avoid many of these difficulties, generalizations from comparative research, though often fruitful, are also tenuous. But, despite the lack of definite research, undiagnosed and therefore untreated lead poisoning is certainly a cause for concern.

45. The biochemistry of lead: review of the body distribution and methods of lead determination—Berman E., Dept. of Toxicol., Hektoen Inst. of Cook County Hosp., Chicago, Ill.—CLIN. PEDIAT. 1966, 5/5 (287-291)

The gastrointestinal and the respiratory tract are the 2 major routes of absorption of lead salts. Most cases of lead intoxication in children result from lead ingestion while the majority of industrial cases follow inhalation of lead dust or fumes. Significant amounts of lead can be absorbed from a shot wound. Organic lead compounds rapidly penetrate the intact skin. Following absorption, lead is distributed to various tissues. Highest initial soft tissue concentration is in the liver and kidney from where, however, lead quickly disappears for deposition in bone. A comparison is made between the previously reported lead levels in tissues and new findings based on autopsy reports. Skeletal lead is fairly inert but under certain metabolic conditions lead may suddenly be mobilized from bones and an acute lead intoxication may ensue. Lead is excreted in feces, urine and sweat. Fecal lead mostly represents lead that was ingested but not absorbed. Urinary lead indicates the degree of lead absorption. Blood lead levels are of value only in acute cases since the blood is rapidly cleared of lead. Blood levels in chronic cases are not remarkable. It is recommended that a blood level of 0-21 μg.% be considered as negative, 21-60 μg.% as evidence of increased lead exposure, and above 60 μg.% as dangerous. There is a discussion of procedures for lead analysis (spectrography, polarography, colorimetry). Recently, atomic absorption flame spectrophotometry has proved to be more sensitive and specific than the older procedures.

46. Childhood lead intoxication. Diagnosis, management and prevention—Chisolm Jr J. J., Dept. of Ped., Johns Hopkins Univ. Sch. of Med., Baltimore, Md.—MED. TMS (N.Y.) 1970, 98/9 (92-106)

Acute lead poisoning in the US occurs mostly in young children who live in deteriorated houses. Of preschool children in selected slum areas, 2-5% show evidence of lead intoxication. Among causative factors listed are: pica, normal mouthing of children and increased oral activity in an emotional state. The peeling paint and crumbling painted plaster in older houses constitute the main hazard to the small child. Other sources of lead are tabulated. Repetitive ingestion of small amounts of lead is usually more dangerous than a single massive exposure. The symptoms of plumbism are protean in character. Initial manifestations include vomiting, anorexia, apathy, hyperirritability, incoordination, delay in the normal development of speech and behavior disorders. The symptoms increase with each toxic episode. Acute encephalopathy is most common in children 15 to 30 months of age. Peripheral neuropathy or cramp-like abdominal pain are mostly seen only in the older child. In early childhood special laboratory tests (whole blood lead, urine lead output) are required to establish the diagnosis of plumbism so that the diagnosis must be tabulated. As to the treatment of symptomatic plumbism, chelation therapy is of primary and the high-risk dwelling. These factors are firm clinical indications for blood lead and other laboratory examinations. The presumptive tests include the qualitative coproporphyrin test, the serum δ-aminolevulinic test, lead in hair, X-rays, blood study and urinanalysis. The clinical significance of various concentrations of lead in whole blood are shown in a table. The clinical classification of the severity of plumbism in children is also tabulated. As to the treatment of symptomatic plumbism, chelation therapy is of primary importance. Appropriate supportive therapy is just as vital to survival as is the selection and correct administration of chelating agents. Control of seizures comes in the first place. The indications for chelation therapy in asymptomatic children are listed. After completion of active therapy the child is hospitalized in a convalescent clinic until a safe dwelling is obtained. Adequate information of the parents and education of the child are an important part of the after-care.

47. Poisoning due to heavy metals—Chisolm Jr J. J., Dept. of Ped., Johns Hopkins Univ. Sch. of Med., Baltimore, Md.—PEDIAT. CLIN. N. AMER. 1970, 17/3 (591-615)

Poisoning due to lead, mercury, arsenic, thallium, cadmium, iron, gold, and copper is discussed. Both acute and chronic poisoning due to these heavy metals cause a variable pattern of multiorgan injury and so should be considered in the differential diagnosis whenever the clinical picture indicates simultaneous involvement of two or more organ systems. Accurate diagnosis depends upon identification by chemical tests of the heavy metal in blood, urine, and sometimes hair and fingernails. Chelating agents (calcium disodium edetate, dimercaprol, D-penicillamine, and deferoxamine) are important and sometimes life-saving adjuncts in the treatment of heavy metal poisonings. Since the chelating agents of choice vary from metal to metal, accurate chemical identification of the heavy metal responsible for the poisoning is also essential for proper therapy. Similarly, accurate chemical identification of the environmental source of the patient's toxic exposure is essential if recurrences of toxic exposure are to be prevented. Dosage and choice of chelating agent vary with the severity of the intoxication. An important principle of chelation therapy is the principle that an adequate molar excess of chelating agent over toxic heavy metal must be provided. Use of insufficient dosage may intensify the intoxication. In some instances, careful supportive therapy is also of vital importance in determining the over-all therapeutic result.

48. Lead poisoning in childhood - comprehensive management and prevention—Chisolm Jr J. J. and Kaplan E., Dept. of Ped., Johns Hopkins Med. Sch., Baltimore, Md.—J. PEDIAT. 1968, 73/6 (942-950)

Attention is draw to the need for a cooperative community approach to the social, environmental, and psychological aspects of the problems of children with lead intoxication. Comprehensive care is just as urgent for the asymptomatic child with an increased body burden of lead as it is for the child with manifest acute plumbism. While chelation therapy for the acute toxic episodes of chronic lead poisoning is deservedly emphasized, hospitalization in a chronic disease facility which has a positive program of child and family rehabilitation serves an important role in the total care of the affected child. Experience in Baltimore and other large cities has shown that coordinated and sustained efforts by health departments, pediatricians, medical social workers, and child guidance workers are essential for an effective program for the prevention and treatment of childhood lead intoxication.

49. Trace metals of the brain and their importance in human disease—Cumings J.N., Dept. of Chem. Pathol., Inst. of Neurol., Nat. Hosp., London—CHEM. WEEKBL. 1967, 63/42 (473-479)

Many trace metals have been found in the cerebral tissues and it is likely that each metal plays some part in various enzyme mechanisms. When the metal is in excess due to poisoning it acts as a cell poison, possibly by direct action on certain enzyme system. The present discussion is limited to manganese, zinc, mercury, lead, and copper. Manganese appears to be an essential element for nutrition. The occipital lobe of the brain contains more manganese than other parts. Manganese *in vitro* will activate certain enzymes. In animals there is a lowered threshold for seizures in manganese deficiency. Men working in manganese mines developed a Parkinsonian-like condition. There is a daily intake of about 10-15 mg. of zinc, practically all of which is excreted in the feces. A low urinary excretion occurs in kwashiorkor and a raised output is found in some forms of acute porphyria and in certain types of cirrhosis of the liver. The zinc content of hair is a guide to zinc deficiency in man. Parts of the hippocampus in guinea pigs contain large amounts of zinc. A small amount of mercury circulates in the blood. It has been shown that following administration of organic compounds of mercury to animals the calcarine area of the brain contained the largest amounts of mercury. Enzyme activity is inhibited by mercury. Inorganic mercury poisoning is largely an industrial hazard. Intoxication following organic mercury occurs in industry or after accidental ingestion. There is a normal intake of copper between 2 and 5 mg. a day. Almost all of it is excreted in the feces. Copper is present in almost all tissues and in the body fluids. Special attention is paid to the copper proteins ceruloplasmin, cerebrocuprein, tyrosinase, monoamine oxidase and hepatocuprein. Copper is toxic to many enzyme systems. Wilson's disease is characterized by a deposition of copper in many tissues, especially in the brain and the liver. The clinical and biochemical features of Wilsons's disease are discussed at length. It has been suggested that in this disease there is a failure in ceruloplasmin synthesis. Recently, isotope studies have facilitated the diagnosis. Treatment of the condition is based on removal of excess copper by chelating agents.

Sources of poisoning, epidemiology and pica studies

50. Accidental poisoning in childhood / Vergiftigungsunfälle im Kindesalter—Reddemann H. and Amendt P., Kinderklin., Ernst-Moritz-Arndt-Univ., Greifswald—ARCH. KINDERHEILK. 1968, 177 (284-295)

The incidence of accidental poisoning in childhood has increased in recent years in all countries. Over a 12 year period 356 infants and children were treated for accidental poisoning. The incidence was highest in the second and third years of life and fell off sharply by 7 years. Over 95% of poisonings occurred in the home. Wrong prescriptions given by doctors accounted for 6.5%. The most frequent form of poisoning was with drugs (39%), with household chemicals next (25%). Other causes were insecticides, rat poison, poisonous plants, gases, alcohol and mercury. Most cases were due to parental carelessness. Prevention of this form of poisoning requires the cooperation of many different sectors, especially the parents.

51. Absorption and excretion of mercury in man. XI. Mercury content of 'normal' human tissues—Joselow M.M., Goldwater L.J. and Weinberg S.B., Div. of Occupat. Med., Sch. of Publ. Hlth and Admin. Med., Columbia Univ., New York, N.Y.—ARCH. ENVIRONM. HLTH 1967, 15 (64-66)

Mercury analyses were performed on 236 samples of tissues removed at autopsy from 39 'normal' human subjects. The samples represented 12 different tissues or organs. The highest values were found in the kidneys. Age did not appear to be a factor in the mercury levels.

52. Pink disease (correspondence)—Stephenson J.B.P., Rayner P.H.W. and Kesaree N., Roy. Hosp. for Sick Child., Glasgow (Stephenson); Child. Hosp., Birmingham (Rayner); Oldchurch Hosp., Romford (Kesaree)—BRIT. MED. J. 1966, 1 (1110-1111)

Dr. Stephenson reports 3 cases of pink disease caused by teething or worm powders. All 3 children excreted large quantities of mercury and were treated with N-acetyl-D-penicillamine. He gives a warning that ointments and powders are not the only source of mercury – mercury seed dressing are available and in the US mercury vapor from wall-paint has been known to cause pink disease. Not all cases of the disease are classically pink, and may therefore be overlooked unless accurate urine mercury estimations are carried out on clinical suspicion. Dr. Rayner recalls a case of pink disease which he saw in 1964, which was due to a mercury-containing dusting powder used for diaper rash. There was some evidence that mercury had played a part in the etiology of primary renal tubular acidosis in an elder sibling. Mercury can be absorbed through even intact skin in potentially toxic amounts and absorption would be enhanced in inflamed skin areas. The toxic effects are not entirely dose-dependent but depend partly on individual sensitivity. He expresses concern that mercury-containing ointment has been reintroduced for diaper rash, which requires only treatment by simple nursing measures. Dr. Kesaree reports a case of a 2 year old girl referred for conjunctivitis resistant to treatment. She was irritable, photophobic, and had the typical appearance and behavior of pink disease. The extremities were unusually pink, but cold and she had an erythematous rash. The mother had been treating a diaper rash with ung. hydrarg. ammon. dil. at intervals over a 5-month period.

53. **Mercury poisoning from application to omphalocele**—Stanley-Brown E.G. and Frank J. E.—J. AMER. MED. ASS. 1971, 216/13 (2144-2145)

The case is reported of a newborn child who died of mercury poisoning following the painting of a giant omphalocele with merbromin. The child, weighing 5 lbs. 8 oz., was born at 36 weeks' gestation. A giant omphalocele was present with an intact sac, and the base measured 5 x 6 cm. The distance from the xiphoid process to the pubic symphysis was 9 x 6 cm. The liver and most of the intestines were within the omphalocele. Initial treatment included intravenous fluid, penicillin, kanamycin sulphate and, through misunderstanding, the exposed sac was painted with 1% merbromin every 3 hours for a total of 3 treatments. This was changed to 2% merbromin every 12 hours on the following day, when oral feedings were started and intravenous fluids discontinued. Oliguria on the second day of life led to anuria on the third day and there was an episode of pink urine. Diffuse sclerema began on the third day. Mercury poisoning was considered and an exchange transfusion carried out. The omphalocele sac was painted with tincture of benzalkonium chloride and hydrocortisone and dimercaprol were administered. On the fourth day of life the sclerema seemed diminished and the infant was more active. Urinary output increased slightly. However, on the fifth day of life, respiratory arrest occurred and the infant died. The blood mercury level in this patient was 30μg./deciliter. Normal patients not exposed to mercury vapor have been found to have levels between 0.6 and 1.2 μg./deciliter.

54. **Congenital mercury poisoning**—Snyder R.D., Dept. of Ped., Univ. of New Mexico Sch. of Med., Albuquerque, N.M.—NEW ENGL. J. MED. 1971, 284/18 (1014-1016)

A case is reported of congenital mercury poisoning in a family with several cases of mercury poisoning acquired by eating pork from pigs fed on seed grain treated with a methyl mercury fungicide. The 40-year-old mother ate pork containing mercury between the 3rd and 6th months of pregnancy, and her urinary mercury levels were markedly elevated in the 7th and 8th months. A 3062 g. male infant was born at term and at 1 minute of life he became dusky and intermittent gross tremulous movements of the extremities developed, but the EEG and EMG were normal; mercury could no longer be detected in the urine. At 3 months the EEG was abnormal with widespread occurrence of spike activity more abundant in the left central and parietal regions. By 6 months generalized myoclonic jerks developed and the EEG was markedly abnormal, with paroxysmal high-voltage spike, polyspike and spike and slow wave patterns. At 8 months the patient was hypotonic and irritable and had nystagmoid eye movements, without evidence of visual fixation. The child was never breast-fed, so he had no opportunity of ingesting food poisoned with mercury. His clinical state was therefore presumably due to transplacental poisoning. His symptomatology was in striking contrast to an absence of symptoms in the mother. This may reflect a special susceptibility of the developing nervous system to damage from mercury. The tremors and EEG abnormalities recall the clinical signs of mercury poisoning in Japan (Minamata disease). Cases of mercury poisoning from misuse of mercury-treated seed grain have been reported in Iraq, West Pakistan and Guatemala. The widespread use of mercury in agricultural and industrial use renders it very liable to enter the food chain. An asymptomatic woman who ingests organic mercury compounds during pregnancy may produce a neurologically defective infant with cerebral palsy, mental retardation, convulsions, involuntary movements or defective vision.

55. The human body burden of lead—Schroeder H.A. and Tipton I.H., Dept. of Physiol. Dartmouth Med. Sch., Hanover, N.H.—ARCH. ENVIRONM. HLTH 1968, 17 (965-978)

Concentrations of lead in human tissues from 33 cities of the US and foreign countries were determined. Differences from place to place were observed, median values generally being higher in US subjects than in those from Africa, the Middle East, and in a few tissues, the Far East. In the US mean values of lead increased with age in the aorta, kidney, bone, liver, lung, spleen, and pancreas; in foreign tissues only aortic lead increased with age. Smooth, striated, and heart muscles and brain had little lead. Bone lead was higher in US subjects than in Far Easterners. Bone contained 91% of the total body lead. At the time these samples were collected (1952-1957) the exposure of US subjects to lead from all sources was apparently large enough to cause accumulation with age, whereas in most foreign areas it was not. It is likely that atmospheric lead from motor vehicle exhausts largely accounts for increased exposures, and that inspired lead may make up a sizable portion of the total amount absorbed by the body. Although experimental toxicity of lead in animals with tissue concentrations similar to those of human beings has been demonstrated, no clinical evidence of bizarre innate toxicity was discovered in these human subjects. In human soft tissues, mean concentrations of lead were not found to displace any of the essential trace elements of low concentration: chromium, manganese, cobalt, copper, or molybdenum. In view of the steadily increasing annual pollution of air and soils with lead from motor vehicle exhausts, innate toxicity in exposed human beings may appear.

56. Plumb unexpected: new source of lead poisoning—DELAWARE MED. J. 1971, 43/1, (19-21)

This editorial discussed the occurrence of lead poisoning following the use of earthenware pottery. In investigation of a recent outbreak, 264 earthenware glazed cups and pitchers, collected in Canada, were tested. It was found that one quarter of these released enough lead to cause severe poisoning, and that half released enough lead to be unsafe for everyday use. Earthenware may be glazed with a frit containing lead not chemically bound and prone to leach into liquids contained in the pottery, especially if these are warm and/or acidic. Handcrafting of pottery is increasing, and only an expert can distinguish easily between earthenware and stoneware; the latter is never made with lead frits. There is no legal requirement for labeling when lead is used in glazing. Cases of lead poisoning following drinking of warm apple juice and of Coke from earthenware containers were mentioned. Use of pewter is also potentially dangerous, though this substance is used less widely.

57. The ubiquity of lead—FD. AND COSMET. TOXICOL. 1966, 4 (532-535)

The ubiquity of lead in the human environment exposes everyone to some extent to this toxic metal. Despite effective control of the industrial environment, shipbreaking, where fumes from anticorrosive paints are produced in small spaces, still presents a considerable hazard. Attention is therefore being focused on the detection of incipient lead poisoning in the subclinical stages. Various parameters have been studied in order to establish the diagnostically most reliable test for this condition. It has been shown that the symptoms correlate most closely with the excretion of the porphyrin precursor δ-aminolevulinic acid (ALA) whereas correlation with urinary lead and coproporphyrin was poor. Urinary ALA was also found to be the most useful diagnostic parameter following penicillamine treatment, thus suggesting that the initial excretion of ALA indicates the size of the metabolically active lead pool. Attention has been drawn to the similarity between lead poisoning and acute intermittent porphyria, although the sites of action differ in the 2 conditions, the liver being the site of deranged porphyrin metabolism, while the bone marrow is the main site of attack in lead poisoning, which in addition may have a direct neurotoxic effect and induce a hematolytic process. Sources of lead intoxication, apart from shipbreaking, are mainly lead-containing paint from old buildings ingested by children and the burning of old battery cases as domestic fuel. Another source of lead poisoning in the home is the use of tinned-steel cooking utensils. A warning against purchase of these utensils has been issued. General atmospheric pollution with lead is mainly attributed to the use of leaded petrol in motor vehicles, but no conclusive connection between chronic subtoxic lead exposure and any specific disorder has as yet been established.

58. Apple-juice colic—LANCET 1971, I (278)

Although now controlled in Britain by statutory regulations, the lead content of pottery glazes is not controlled by legislation in many countries. In a report from Canada, lead-poisoning in 2 young brothers is described, one of whom died after apple-juice had been stored in a lead-glazed earthenware jug. The authors obtained 117 samples of Canadian-produced and imported earthenware vessels and prepared an additional 147 pieces of glazed pottery with glazes used by amateur und professional potters. Half of all the glaze-surfaces tested contained sufficient lead to cause chronic poisoning (yielding more than 7 mg./l. lead in 4% acetic acid stored in the vessel for 18 hours). A quarter of all homemade handcraft and a tenth of imported and commercial earthenware were more dangerous, yielding a concentration greater than 100 mg./l. in their standard test, a concentration sufficiently high to cause severe acute poisoning in small children if an acidic fluid was stored in it.

59. Child lead paint poisoning still prevalent—MARYLAND MED. J. 1968, 17 (137-138)

Child lead poisoning from ingested lead paint is still prevalent in Baltimore City as shown by the number of cases recorded since 1931. The drop in the number of cases observed in 1967 is ascribed to the relatively cool summer of that year since it is known that the risk of lead encephalopathy is much greater during warm summer months. It is pointed out that every child showing initial symptoms such as anorexia, apathy, hyperirritability, incoordination and loss of recently acquired skills should be considered suspect for lead poisoning. Appropriate kits are made available by the local health authorities on request. If lead ingestion continues the symptoms intensify and the classic signs of increased intracranial pressure appear. The age distribution of the 1111 cases of lead poisoning recorded since 1931 shows that a large majority of cases fall within the age group 1-3. Warnings to the public have been issued through the mass media and physicians who deal with young children are in a strategic position to warn high risk families of the lead danger and to take appropriate steps if symptoms appear.

60. Effects of particular pollutants. Mercury pollution in Sweden with special reference to conditions in the water habitat—Ackefors H., Inst. of Mar. Res., S-453 00 Lysekil—PROC. ROY. SOC. LOND. 1971, 177 (365-387)

During the 1950s and 1960s, great attention was paid to the Hg problem in Japan and Sweden. In Sweden the whole environment was contaminated due to the widespread use of Hg in agriculture and industry. The organic Hg compounds of alkyl-type and aryl-type, which were used for 10 to 20 years as fungicides in agriculture and in the pulp industry, have had serious effects on animals in both terrestrial and aquatic environments. These two types of Hg compounds are now forbidden in Sweden. However, a new type of compound, alkoxyalkyl-type, may now be used as a fungicide in agriculture. Much Hg is discharged into the air and water due to industrial activities, *e.g.*, the chlorine-alkali industry and many other activities such as the burning of waste products containing small amounts of Hg. Although most Hg is inorganic or organic in the form of phenyl-Hg (aryl-type) (discharged as industrial wastes), most of the Hg in fish from lakes and the Baltic in Sweden is present as methyl-Hg (alkyl-type). It has been demonstrated that methylation of Hg takes place due to bacterial and enzymic activity. High Hg contents in the wild fauna, grain-eating birds and their predators, gave the first scientific evidence that the terrestrial environment was contaminated. Since the ban on alkyl-Hg in agriculture was introduced the Hg concentrations in birds living in the terrestrial environment and of food such as eggs, pork, *etc.*, produced on land, have dropped. Unfortunately this is not the case in the aquatic habitat. Although the discharge of Hg to water and air has been restricted in Sweden, the whole environment is so heavily contaminated that it will take a long time for the Hg concentrations to decrease. The most serious Hg problem in Sweden today is the high Hg concentration in fish. Fish from a certain number of lakes and from extensive coastal areas on the Swedish east and west coasts are now forbidden for sale in Sweden. In general, water organisms or birds feeding in the water habitat have higher 'natural' contents of Hg than terrestrial wildlife. Pike has been chosen as an indicator organism of Hg contamination. Levels higher than 200 ng.Hg/g. are considered abnormal. Most of the investigated fishes from freshwater and coastal areas have concentrations in the range of 200 to 1000 ng.Hg/g. Fish with more than 1000 ng.Hg/g. exceed the temporary limit of 1 mg.Hg/kg. (1000 ng./g.) now valid in Sweden. Earlier, FAO/WHO proposed a practical residue limit up to 0.05 mg.Hg/kg. (50 ng./g.) for terrestrial food. The effects of Hg intake in man were first observed in Japan. During the years 1953 to 1960, 111 persons living around Minimata Bay, were killed or seriously disabled. They were poisoned by fish and shellfish with elevated Hg concentrations. In Sweden elevated Hg concentrations have been observed in blood corpuscles, blood plasma and hair of people eating very much freshwater fish, but also the people eating saltwater fish.

61. Conservative treatment of umbilical hernia with mercurochrome / Breitag zur konservativen Nabelschnurbruch-Behandlung mit Mercurochrom—Schippa R. and Wehran H.J., Klin. und Poliklin. für Kinderchir., Karl-Marx-Univ., Leipzig—KINDERCHIR. 1968, 6/3 (319-326)

Thirteen cases of large exomphalos seen between 1963 and 1966 who were treated with mercurochrome are reported. In at least 5 children there were clinical symptoms of mercurochrome absorption, which caused death with symptoms and signs of intoxication. The estimation of mercury in the urine and the organs of 6 fatal cases and of 2 survivors showed a high mercury concentration. It is likely that mercurochrome itself or one of its decomposition products are toxic. There was no conclusive evidence of a mercury poisoning. Treatment with mercurochrome can therefore no longer be considered the treatment of choice as a conservative means of managing large exomphalos.

62. Mercury poisoning through eating fish? / Metylkvicksilverförgiftning genom förtäring av fisk?—Birke G., Johnels A.G., Plantin L.O., Sjöstrand B. and Westermark T., Konung Gustav V's Forskningsinst., Stockholm—LÄKARTIDNINGEN 1967, 64/37 (3628-3637)

Previous research on the concentration of mercury in nature is surveyed. In recent years there has been a striking increase in the mercury content of the fish in many Swedish lakes. People who eat unusual quantities of fish have therefore been examined, and several have shown high concentrations of mercury in the blood, which, however, slowly declined after a change of diet. No reliable cases of serious clinical symptoms caused by the high content have yet been recorded, but the concentration in these people is of an order of magnitude such that they should avoid a large consumption of fish with clearly increased contents of mercury. The reorganization of the emission of mercury-containing substances in natural surroundings should also be intensified.

63. Pica and poisoning—Lourie R.S., Child. Hosp., Washington, D.C.—AMER. J. ORTHO-PSYCHIAT. 1971, 141 (697-699)

Some children suffering from plumbism were found to have ingested not paint but newspaper. Pica may result not only in lead intoxication but also, for example, methemoglobinemia from the ingestion of crayons. Severe anemias resulting from persistent pica were observed as far back as 1865. The most consistent factor found in pica is unavailable mothering. For various reasons ranging from overwork to alcoholism, mothers are not available to stop the child's habit. Pica has been found to disappear when the mother became more available to the child. It is only in the most resistant cases that psychotherapy has been found necessary. The program of action started in Washington provides for every child with pica to be screened as a presumptive lead poisoning case and the incidence of lead poisoning cases detected, mostly preclinical, has risen by more than 300%. The removal of all lead from the child's environment is obviously an important preventive measure but it is over-simplifying the question to explain pica as resulting from an unstimulating environment. Removing the sources of lead will not correct the conditions facing the mothers of children who would not have pica if the mothers were available to stop them.

64. Epidemiology of lead poisoning in New Haven children - operational factors—Meigs J.W. and Whitmire E., Dept. of Epidemiol. and Publ. Hlth, Yale Univ. Sch. of Med., New Haven, Conn.—CONN. MED. 1971, 35/6 (363-369)

Childhood lead poisoning in New Haven was studied from the standpoint of operational characteristics of families whose children had the condition. A sample of families with lead poisoned children was matched by age and sex against families with children with 2 other conditions: inguinal hernia treated surgically, and pneumonia. Families with lead poisoned children were significantly more likely than the matched controls to: be black; have marital separation; have a father unemployed; have a mother employed or at school; have more children in the family; have the index child supervised by someone other than the mother; live in poor housing; be a recipient of public assistance; have serious family problems. A second sample, drawn from all children hospitalized from April to September 1969 was studied similarly. Black families in general differed from white families with respect to the foregoing variables. Within the group of 58 black families, those with lead poisoned children differed significantly from all other black families and in the directions previously described. It is concluded that black families generally are coping with operational problems that are significantly less prevalent among white families. When the overload becomes too great childhood lead poisoning is likely if children have access to lead. Control of this syndrome will require attention to family operation as well as improvement of the physical environment.

65. Lead poisoning in blind children—Ames A.C. and Swift P.N., Dept. of Chem. Pathol., Lewisham Hosp., London—BRIT. MED. J. 1968, 3/5611 (152-153)

Many partially sighted children use the mouth, lips, and tongue as an aid in identifying objects - this has been termed discriminatory pica. Investigation of a case of lead poisoning in a pupil at a residential school for the blind led to the discovery of others with asymptomatic lead poisoning, all of whom had the same habit. All the children recovered without treatment when they abandoned their habit of discrimination by use of the mouth. Authorities responsible for schools for the blind should be aware of this risk.

66. Factors influencing exposure of children to lead—Barltrop D. and Killala N.J.P., Paed. Unit, St Mary's Hosp. Med. Sch., London—ARCH. DIS. CHILDH. 1969, 44/236 (476-479)

Paint samples from 56 homes of 103 children aged 1-14 years were obtained. The lead content of the samples was related to the age of the building and to the social class of the family; 53% of the samples contained more than 1% of lead. Old houses, and families of low social class, were frequently associated with indoor paints of high lead content. Lead paint applied several decades ago, even if infrequently covered by other paint, may still continue to provide a potential hazard. Detection and removal of lead paint already *in situ* should therefore be the aim in preventing lead poisoning of children from this source.

67. Environmental lead and its paediatric significance—Barltrop D., Dept. of Clin. Sci., Paed. Unit, St Mary's Hosp. Med. Sch., London—POSTGRAD. MED. J. 1969, 45/520 (129-134)

There is evidence that appreciable body burdens of stable and radioactive lead may be acquired by children and also that part of the maternal intake of lead may influence the fetus. The rapid growth rate, immature metabolic apparatus and varying dietary patterns which characterize the pediatric age groups suggest that standards for adult males might not be applicable. Numerous environmental sources may contribute to the lead intake of children but the metabolism of lead in this group is not well understood and deserves further study.

68. The prevalence of pica—Barltrop D., Dept. of Ped., Harvard Med. Sch., Child Hlth Div., Child.'s Hosp. Med. Cent., Boston, Mass.—AMER. J. DIS. CHILD. 1966, 112/2 (116-123)

The prevalence of pica in random samples of children, selected for age and color, was determined from parental observations. Information was obtained by interview concerning 439 children and by mailed questionnaire concerning 277 children. The prevalence of pica and the range of articles ingested decreased with increasing age over the age range studied (1-6 years). The siblings of white children with pica were more likely to have pica than the siblings of unaffected white children. The occurrence of pica was related neither to the sex, race, family rank, place of birth of the parents, nor to the size or social position of the family. The prevalence of mouthing and several other age-dependent activities simultaneously determined using the same techniques, showed characteristic variations with age. Pica is not uncommon in children 1 to 6 years of age.

69. Respiratory exposure to lead: epidemiological and experimental dose-response relationships—Goldsmith J.R. and Hexter A.C., California State Dept. of Publ. Hlth, Berkeley, Calif.—SCIENCE 1967, 158/3797 (132-134)

Epidemiologic studies of blood lead levels in general and occupational groups show a logarithmic regression on estimated atmospheric exposure. Experimental results at the same and higher levels show a dose-response relationship which fits the same regression. The data imply that long-term increases in atmospheric lead will result in predictably higher blood lead levels in the exposed populations.

70. Chronic lead poisoning in children: a review of 90 children diagnosed in Sydney, 1948-1967—Freeman R., Dept. of Paed., Prince of Wales Hosp., Sydney—AUST. PAEDIAT. J. 1969, 5/1 (27-35)

In the past 20 years, 90 children with chronic lead poisoning, mostly due to the ingestion of peeling paint, have been diagnosed in Sydney. Eleven of the children died and at least 30% have serious neurological or renal sequelae. The aim of this brief review is to renew interest among the medical profession in this hazard, for only by early diagnosis and appropriate treatment will this sad picture be improved. It is also hoped to stimulate measures to rid our society of a preventable disease.

71. Chronic lead poisoning in children: a review of 90 children diagnosed in Sydney, 1948-1967. I. Epidemiological aspects—Freeman R., Dept. of Paed., Prince of Wales Hosp., Sydney—MED. J. AUST. 1970, 1 (II) (640-647)

Chronic lead poisoning in children was prevalent in Queensland, Australia, in the early part of the century, but legislation restricting the lead content of paint has practically eliminated the hazard in that state. There have been few reports of childhood plumbism from the other states, where it has not been considered a problem. However, 90 children diagnosed in Sydney between 1948 and 1967 show that it is a common hazard in New South Wales. Most of the children were poisoned after ingesting lead-based paint peeling off the walls of their homes. The incidence was highest in 3 of the older municipalities, but individual cases came from many other parts of Sydney, which suggests that the hazard is widespread. In a few cases, the only source of lead was from toys, which are available today in toy shops. It is hoped that this and subsequent reports will stimulate measures to eradicate a serious and preventable disease from our community.

72. Lead in environments (Japanese)—Tada O., Div. of Hyg., Inst. for Sci. of Labour, Tokyo—J. SCI. LABOUR (TOKYO) 1970, 46/10 (577-583)

Reports of studies on lead in environments of living, in atmospheric air and in working environments are discussed. Lead occasionally causes intoxications in workshops where the fume and dust control is insufficient. The air pollution by automotive emissions over the city streets has become a serious problem of public health with the increase in traffic. Polluted air contains lead from the emissions of automobiles, and attention should be paid to the accumulation of lead in the bodies of city dwellers due to the rise in concentration of atmospheric lead. The effect of lead absorption on human health depends on the quantity and duration of lead-absorption from the air. The possibility of lead being absorbed by the body through food and beverage should not be ignored.

73. Lead poisoning at Bradford—Turner W., Bamford F.N. and Dodge J.S., Hlth Dept., Bradford—BRIT. MED. J. 1967, 3 (56)

The presentation of 2 young children with convulsions, in the absence of a history of epilepsy, and the deaths of several animals with convulsions in the same neighborhood, caused the local Medical Officer of Health to investigate the home and surroundings of these children. It was found that battery cases had been burnt in their house and in others nearby, the casings being obtained from scrapyards. The 2 children whose illness had prompted investigation died despite calcium disodium versenate treatment. Five other children and 2 adults found in the initial examination of residents in houses where battery cases had been used for fuel were thought to have lead poisoning and were hospitalized. The plastic battery case is probably non-toxic but substantial quantities of lead adhere to it. Toxic ash remains after burning, is probably ingested and possibly inhaled. Indiscriminate dumping of these cases should be prevented by legislation.

74. An outbreak of lead poisoning of bread in Malta—Vassallo L.—J. ROY. NAV. MED. SERV. 1971, 57 (37-40)

An usual outbreak of lead poisoning occurred in Malta in 1903 and 1904 due to widespread contamination of Maltese bread by lead salts. Varying degrees of poisoning occurred among the population. Most people were treated at home but 9 patients were admitted to hospital staying for an average time of 2 weeks. There were no deaths. The source of the lead was lead painted wood burned directly on the floors of the ovens to heat them. The contaminated ashes were then swept away and the loaves put on the heated floor for baking. The painted wood used came from a naval ship which had been sold for scrap.

75. Pink disease from cutaneous absorption of mercury—Ward O.C. and Hingerty D.—J. IRISH MED. ASS. 1967, 60/357 (94-95, 98)

A case report of mercury intoxication due to cutaneous absorption in an 11-month-old child is presented, and the symptomatology, etiology and possible mechanisms of pink disease (erythredema polyneuropathy) are discussed. After all other possibilities (including the child's playthings) had been ruled out, it was concluded that inorganic mercury had been absorbed from a 2% ammoniated mercury ointment (2 ounces used over 2 periods of 7-10 days with a 1-month interval) prescribed for seborreic dermatitis. A 24-hour urine specimen was found to contain 40 μg. of mercury (60 μg./100 ml.). After 6 weeks' treatment with 750 mg. of penicillamine daily, the patient was fully recovered clinically. The mechanism by which mercury produces the clinical picture of pink disease remains obscure. Mercury is taken up especially by the kidney, has a marked diuretic effect, acts as a general protoplasmic poison by combining with the sulfhydryl groups of proteins, and at low concentrations can inhibit many enzyme systems. Potentiation of catecholamine activity, especially of the effects of a normal circulating blood catecholamine level, seem a plausible explanation of many of the symptoms. The diuretic action may be an important factor. Since many enzymes are sulfhydryl-dependent, it is unlikely that the varied symptoms of pink disease could be explained on the basis of a single inhibitory action of mercury.

76. Lead poisoning from eye cosmetic—Warley M.A., Blackledge P. and O'Gorman P., Brook Gen. Hosp., London—BRIT. MED. J. 1968, 1 (117)

The authors report lead poisoning in 3 members of an Indian family resident in England; 1 adult and 2 children were involved; the interesting feature of the case was the difficulty with which the source of lead was identified. Investigation of paintwork, water supply, cooking utensils, food *etc.*, were negative. It was eventually found that the 3 affected people all used a mascara-like substance applied to eyelids and conjunctivae, for cosmetic or 'health' reasons. This powder contained 80% lead sulphide. Treatment has been successful in deleading these patients, though the child whose admission with lead encephalopathy sparked off the investigation was gravely ill and the prognosis for his mental development is uncertain. Use of powders originating from India and Pakistan for the above purposes is not rare and the implications are serious. Some Indians and Pakistanis resident in England use a home-made carbon paste instead.

77. An outbreak of lead poisoning—Fernandes M.T., London Borough of Redbridge, London—MED. OFFR 1969, 122/6 (88)

In this outbreak of lead poisoning there were 4 people at risk: the father, the mother, and 2 sons aged 4$^1/_2$ and 1$^1/_2$ years. Another son, aged 3$^1/_2$ years, had already been admitted to hospital with a suspected case of gastroenteritis. After further examination it was confirmed and proved to be a case of severe lead poisoning with lead encephalopathy. The boy was seriously ill, lying in a coma, and X-rays of the abdomen showed a heavy opaque shadow presumably due to the heavy lead content. On notification steps were taken to investigate the whole family, as well as to take other preventive measures in the borough. Lead estimations of the 2 other children showed lead contents of 53 and 46 μg.%, whereas that of the father and mother were within normal limits. Samples of paint revealed 3.2% W/W of lead, which was above the permissible limit of lead, the normal being 1.6%. Analysis of the plaster, putty, and water were normal for lead. The 2 children were admitted to hospital, being at risk, for further treatment. The original case (the boy of 3$^1/_2$ years) improved more slowly and was discharged 3$^1/_2$ months after admission. Investigations revealed that a cosmetic was being used, called 'Surma'. Analysis of this sample showed it contained 88% lead sulphide. The sample was removed from the house and all Indian grocers in the borough were approached and asked not to sell any more of this eye cosmetic.

78. Pink disease—Feldman G.V. and Harris P.F., Duchess of York Hosp. for Babies, Manchester (Feldman); Child. Hosp., Sheffield—BRIT. MED. J. 1966, 1 (977)

In letters to the editor 3 cases of pink disease are mentioned. In 2 cases mercurial ointments were applied to a diaper rash. The third, a 21 months old boy, was referred to an outpatient department on account of weight loss. On examination he looked as if he had lost weight; he was pulling his hair out, and scratching his wrists and feet. His hands and feet were unusually pink, and he was perspiring. There were no other abnormal physical signs. The urine mercury was 56 μg./100 ml. The mother stated that she had been administering teething powders intermittently since the age of 8 months. The powders were Steedman's, and they contained 26.7% of hydrargsubchlor.

79. Soil lead and pediatric lead poisoning in Charleston, S.C.—Fairly F.S. and Gray III J.W. —J.S. CAR. MED. ASS. 1970, 66 (79-82)

Lead levels of the soil of the peninsular city of Charleston, S.C. were very high. Although the source of the soil lead has not been determined, city-wide fires, pesticides, automobile exhausts and native lead have been eliminated as reasonable sources for the high soil lead content. Pica is common among children under 6, and soil lead levels are sufficient to cause chronic pediatric lead poisoning. Furthermore, the yards of houses where pediatric lead poisoning has occurred contain large amounts of lead, and most cases of pediatric lead poisoning occur in an area of high soil lead values.

80. Pink disease - ten years after (The epilogue)—Dathan J.G. and Harvey C.C.—BRIT. MED. J. 1965, 1/5443 (1181-1182)

The incidence and mortality rate of pink disease have fallen dramatically since teething powders containing mercury were withdrawn from the market in 1954. In one pediatric practice in South Yorkshire, England, an average of 9 new cases had been seen annually during the period 1948-1954, whereas only 4 cases have occurred since. The national deathrate from pink disease shows a similar decline, from 57 in 1950 to 7 in 1955, and to none in 1961 and 1962. A fatal case occurring in 1963 is described where out-of-date mercury-containing teething powders, bought from a village shop in Oxfordshire, had been administered. The divergent views on the causation of pink disease are discussed, and the results of this survey interpreted as conclusive evidence that this disease is caused by the ingestion of mercury.

81. The lead content of breast milk and its substitutes / Teneur en plomb du lait humain et de ses produits de substitution—Noirfalise A., Heusghem C. and Legros J., Lab. de Toxicol., Fac. de Méd., Univ. de Liège—ARCH. BELGES MED. SOC. 1967, 25/2 (73-79)

Seventy-six samples of breast milk were studied from women without manifestations of lead poisoning, all of whom lived in the area of Liège. Also studied was the lead content of 10 samples of milk substitutes, 25 samples of cow's milk from the Liège area, and 10 samples of bottled cow's milk. The technical details of qualitative and quantitative determination of lead are briefly described. Results showed that 96.05% of the samples of breast milk contained less than 100 μg.% lead; 84.21% contained less than 50 μg.%; 2.63% contained less than 10 μg.% lead. The samples of powdered dry milk had a mean content of 19.8 ± 3.4 μg.% lead. When diluted, the mean lead content was reduced to 2.6 ± 0.4 μg.% lead. Cow's milk collected in the dairy had a mean lead content of 8.2 ± 2.5 μg.%. In bottled milk, the mean lead content was 13.6 ± 4.8 μg.%. A number of general data on the metabolism of lead are given. In a previous study the authors had found a mean value of 40-50 μg.% lead in blood. There seems to be a certain parallel between the lead contents of blood and those of breast milk. The possible metabolic disorders caused by the ingestion of lead in breast milk have not yet been determined.

82. Lead poisoning: risks for pencil chewers?—Pichirallo J.—SCIENCE 1971, 173 (509-510)

In the 16th century graphite replaced metallic lead as the main ingredient in pencil points, but the term lead pencil has persisted. Recent studies confirm, however, that this term is perhaps not a misnomer. The paint covering most pencils contains lead. Though 1% lead in paints is considered safe, the percentage in paints on pencils was found to be greater. In a report of the Department of Health, Education, and Welfare's Bureau of Community Environmental Management the weight of lead in some wooden pencils ranged from 0.1146 to 1.037 mg. This amount is high enough to make them harmful for a pencil-chewing child. Similar studies were done in New York City and in Washington, D.C. It was found that the paint on 51 of 138 pencils contained more than the approved 1% level of lead. Leaded paints were detected in 17 different brands of pencils manufactured by 6 different companies. The safety of the 1% level of lead is also disputed by some experts. In Washington D.C. pencils painted yellow or green had a high lead content. Samples of the large round pencils used in the primary grades in public schools also contained excessive lead. In the US the responsibility for the removal of hazardous pencils from the market rests with the Food and Drug Administration, but at the moment they believe there is insufficient evidence to take any action.

83. Untaxed whiskey and fetal lead exposure—Palmisano P.A., Sneed R.C. and Cassady G., Dept. of Pharmacol., Univ. of Alabama Med. Cent., Birmingham, Ala.—J. PEDIAT. 1969, 75/5 (869-871)

A 10-week-old infant with evidence of neurologic defects, intrauterine growth retardation, and postnatal failure to thrive was studied for abnormal lead accumulation because of a maternal history of long-term ingestion of untaxed whiskey. After challenge doses of CaEDTA, the infant and the mother each excreted an abnormally large amount of lead in the urine. These data provide suggestive evidence of transmission of lead transplacentally. Because of the widespread ingestion of untaxed whiskey in the southeastern US, intrauterine lead exposure may be a cause of fetal and neonatal disease.

84. Epidemiological study of a disease in the Guatemalan Highlands believed to be encephalitis / Estudio epidemiologico de una enfermedad considerada como encefalitis en la región de los altos de Guatemala—Ordónez J.V., Carrilo J.A., Miranda M. and Gaie J.L., Dept. de Microbiol., Fac. de Cienc. Méd., Univ. de San Carlos de Guatemala, Guatemala—BOL. OFIC. SANIT. PANAMER. 1966, 60/6 (510-519)

In 1965 an epidemiological study was made in an agricultural area of Guatemala to establish the etiology of a disease affecting certain families. The involvement of the central nervous system gave the impression that the disease was an encephalitis of undetermined etiology. The persons afflicted were Indians living in the mountains and cultivating corn and wheat. Except for small wooded areas, most of the land is cultivated; part of the crop is sold and the remainder kept for food. The water they drink comes from mountain springs, and there is no system of excreta or garbage disposal. Insects are not plentiful in the area. During a 4-month period 45 cases occurred and of these 20 died. Only 12 families were affected. Over 50% of the cases occurred among children under 10 years of age, and 75% among those under 20 years of age. There was no case among children under one year of age. The death rates were similar for all age groups. The predominant symptoms of the disease were: loss of the use of extremities; blindness; deafness; and loss of consciousness. Among significant laboratory findings mention should be made of the absence of changes in the spinal fluid and high levels of albumin (0.5-2 g./liter) in the urine. It was discovered that the solution with which the wheat used for sowing had been treated had a high mercury content, and investigation showed that the families in which the disease occurred had used part of this seeding wheat for food, despite the clear warning printed on the wrapping. A toxicological examination of a mixture of organs taken from a dead patient revealed the presence of 15 μg. of mercury. An examination of other samples of post mortem material, as well as wheat seeds, was also positive for mercury. The conclusion reached was that the cause of the disease was mercury poisoning resulting from the ingestion of wheat treated with that substance.

85. Pica and blood lead in psychotic children—Oliver B.E. and O'Gorman G., Smith Hosp., Henley-on-Thames—DEVELOP. MED. CHILD NEUROL. 1966, 8 (704-707)

Of 40 children aged 3-13 years resident in a long-stay unit for severely disturbed and psychotic children, 17 (43%) showed frequent pica and 9 (22%) occasional pica. Twenty-three (58%) had blood lead levels of over 36 μg./100 ml. and the high blood lead levels were associated with frequent pica except in 2 cases in which it was entirely absent. Two patients with 'intermediate' lead levels also showed no pica. Of a total of 26 patients with pica, blood lead levels within the normal range were found in 7 (2 with frequent pica and 5 with occasional pica). Thus 26.9% showed no rise in blood lead above normal as a result of the pica habit. It was not found possible to discover why 2 patients with frequent pica had normal blood lead levels. Possibly there are causes other than pica for raised blood lead levels. Possibly the 2 children with frequent pica fortuitously chose lead-free objects. Some patients in whom pica was not observed may have indulged in it surreptitiously or had had periods of pica which had ceased. The main sources of lead appear to have been paint work, toys and rubbish, but children exhibiting pica chewed a wide variety of materials. The authors suggest further lines of research, including the time-factor between the onset of pica and the elevation of blood values and the effect of various chelating agents. The planning of a lead-free environment could affect the planning of long-stay care units for children.

86. Lead and the legislature - 1971—Oliver R.G.—CONN. MED. 1971, 35 (498-500)

In spite of the existing legislation designed to minimize the risk of lead poisoning the danger still exists. The 1971 legislative package prepared by the Connecticut Governor's Lead Task Force aimed at furthering the reinforcement of the existing laws and at attempting to attack the main source of lead poisoning in the interiors of dilapidated houses. One Bill will require notification of the name and address of any person found to have a level of blood lead equal to or greater than 0.04 mg./100 g. of blood or any other abnormal body burden of lead. The local Director of Health will then be required to investigate the source of the lead and report to the local building official who will, in turn, be required to take action to prevent further exposure. If necessary, this may include rehousing of the family. Other Bills in the package are designed to secure adequate screening and diagnostic facilities, to set up Citizens Advisory Committees and to create housing divisions in the Circuit Courts. Specially assigned judges and prosecutors in these Circuit Courts would have jurisdiction over matters relating to housing code violation and housing discrimination offenses.

87. Mercury poisoning—Swales J.D., Dept. of Med., Univ. of Manchester—NURSING TIMES 1971, 47 (409-410)

The various sources of mercury poisoning are described. Besides the occupational hazards of working with mercury and the problem of high concentrations of methyl mercury in sea fish, the effect of mercury poisoning in children is discussed. Mercury poisoning in children produces 2 diseases that were not uncommon in the post-war years: pink disease and infantile renal tubular acidosis. Infants with pink disease show mysterious failure to thrive, excessive sweating and dilated peripheral blood vessels, which give the flushed appearance. The child is also fretful and irritable. In infantile renal tubular acidosis failure to thrive is associated with a failure to acidify the urine, resulting in acidosis. In 1954 the decline in the incidence of renal tubular acidosis was ascribed to the withdrawal of mercury compounds of teething powders. Likewise the incidence of pink disease declined, which seemed associated with the elimination of dusting powders containing calomel.

88. Lead poisoning from an unusual source—Srivastava P.C. and Varadi S., Dept. of Haematol., Northern Gen. Hosp., Sheffield—BRIT. MED. J. 1968, 1 (578)

Hemolytic anemia due almost certainly to lead poisoning was diagnosed in a 15 year old girl. Both blood and bone marrow findings confirmed the clinical diagnosis, and urinary lead was high. However the source of the lead was unidentifiable. It was then noticed that the patient wore an unusual bright salmon-pink lipstick, which turned out to be ointment which her grandmother used for skin blemishes and bunions; this proprietary preparation, sold without prescription, had been used by the patient, who was a lip biter, as lipsalve/lipstick. It was calculated that she had ingested about 45 g. of elemental lead in the course of her use of this ointment which contains 67% basic lead carbonate. The ointment jar was labeled for outward use only but possibly this warning is insufficient. The patient is now well both clinically and hematologically. Reference is made to another cosmetic, surma, a mascara-like substance used by women from India, which has also been responsible for lead poisoning and has proved to be a source which may be missed in history-taking.

89. Short and long-term effects of acute poisoning—Done A., Univ. of Utah, Salt Lake City, Utah—US PUBL. HLTH SERV. PUBL. NO. 1791 1968 (155-163)

Of the accidental poisonings each year about 500 occur in children 5 years or under. In this group lead poisoning is the 3rd most common cause of death and it is the main cause of mental retardation. Up to 10 severe cases of lead poisoning occur for each fatal case. Data available relating brain damage to poisoning and use of drugs show that there is mental deterioration. Inadequacy of the measuring techniques used may be the reason for brain damage not being detected.

90. Lead poisoning in childhood: epidemiology, manifestations and prevention—Jacobziner H.—CLIN. PEDIAT. 1966, 5 (277-286)

Lead poisoning in children is a major health problem in big cities. It is fatal in 15-20% of cases and the encephalopathy leaves neurological and mental sequelae in over 25% of the survivors. It used to be recognized only when there were clinical signs of CNS irritation, and little was known of the subclinical cases. The toxic agent is usually house-paint containing lead. Poisoning may arise from inhaling lead fumes, or by absorption through the skin, but usually the lead is ingested, and pica is a valuable clue to the occurrence. In a New York City study, over 30% of children with pica had lead poisoning (shown by a blood-lead level over 0.06 mg./100 ml.). Symptoms may be absent but they may include anorexia (18%), vomiting (9%), abdominal pain or constipation, hypochromic anemia, encephalopathy (12%), stupor, lethargy or convulsions, and X-ray signs of increased density in the long bones (24%), or opacities representing lead flakes in the abdomen (2%). Over half the deaths from lead poisoning are in 2-year-olds. The incidence is highest in slum areas here the houses are dilapidated. Asymptomatic lead poisoning occurs all through the year but lead encephalopathy is commoner in the summer, when stored and ingested lead is more easily absorbed and distributed to the tissues because of greater ultra-violet ray exposure, and the nerve cells are more susceptible to lead poisoning. It is important for doctors to be on the alert for cases of lead poisoning. When such cases are reported in New York, the home is inspected. The mother is questioned about pica in children under 7 years, their urine is tested and possible sources of lead are investigated. Landlords are required to comply with the health code in repainting. The most reliable procedure for identifying lead intoxication in asymptomatic cases is to determine the blood-lead level. This gives positive results in 37% of suspected cases, against 5.5% for raised urinary coproporphyrin levels. Other possible diagnostic tests include lead excretion after an intramuscular dose of sodium calcium EDTA, red fluorescence of the erythrocytes, and pigmentation of the retina. Lead poisoning is preventable and strenuous efforts should be made to eliminate it, including improvements in the physical environment and health education to demonstrate the harmful effects of pica.

91. Mercury poisoning in infancy—Egan B. and McNicholl B., Reg. Hosp., Galway—BRIT. MED. J. 1966, 1 (1482)

The case is presented of an 11-month-old boy admitted to hospital with anorexia, irritability, weight loss and intermittent constipation. There was pyrexia, gingivitis and cervical adenitis. In the following 5 weeks the clinical features of pink disease developed and a 10-day course of dimercaprol was given. It was thought that the child had ingested ointment used for a facial rash. The ointment was tested and found to have a high mercury content. Some improvement followed the course of dimercaprol but the infant died in the 11th week of his hospital stay, following fulminating bronchopneumonia. Organ and urine analysis then failed to demonstrate mercury; bone was not analyzed.

92. Mercury poisoning in infancy (correspondence)—Hunt G.M.—BRIT. MED. J. 1966, 1 (1482)

A case is reported in which a breast-fed baby's stools became pea green on the second day of life. Her diarrhea improved when bottle-feeding was substituted but returned with further breast-feeding. The mother developed an erythematous rash on her breasts and the child a rash on chin, forehead and neck. The mother had been using lotio hydrargyri perchloridi 1 : 2000 (in water) for cracked nipples and the amount used between the second and tenth day from the baby's birth contained about 100 mg. mercuric chloride. Eleven days after discontinuing the lotion the mother's urine contained only 13 mg./100 ml. of mercury and the baby's 2 mg./100 ml. The baby at no time developed any signs of pink disease.

93. **Hair trace metal levels and environmental exposure**—Hammer D.I., Finklea J. F., Hendricks R.H., Shy C.M. and Horton R.J.M., Div. of Hlth Effects Res., Dept. of Hlth, Educ. and Welf., Durham, N.C.—AMER. J. EPIDEMIOL. 1971, 93/2 (84-92)

Hair trace metal levels were related to environmental exposure in a study of fourth-grade boys in cities representing exposure dose gradients for arsenic (As), cadmium (Cd), copper (Cu), lead (Pb), and zinc (Zn). Hair samples were carefully and stringently washed before analysis for As by spectrophotometry and for Cd, Cu, Pb, and Zn by atomic absorption spectroscopy. Hair trace metal distributions for As, Cd, Cu, and Pb were positively skewed while those for Zn were symmetrical. Means were in accord with exposure rankings for As, Cd, and Pb but not for Cu and Zn. When grouped across a ranking gradient, differences among the means for As, Cd, and Pb were statistically significant while those of Cu and Zn were not. The present study minimized possible effects of age, sex, hair color, varying hair length, and chemical treatments. Despite the problems of exogenous deposition, endogenous absorption routes, and relationships of hair metal to body burden, mean hair metals levels for As, Cd, and Pb accurately reflected community exposures.

94. **Epidemiology of increased lead exposure among 954 one-five year old Hartford, Connecticut, children-1970**—Hale M. and Lepow M.L., Univ. of Connecticut Sch. of Med., Hartford, Conn.—CONN. MED. 1971, 35/8 (492-497)

In a survey of 954 small children for lead poisoning, 60 were found to have increased urinary δ-aminolevulinic acid (ALA) levels. Nine received treatment for elevated lead levels. Poor housing and pica characterized over half of the population surveyed. Children with +ALA levels generally lived in poor housing, had a higher prevalence of pica and a higher prevalence of pica for paint than the general population. Black children had a higher prevalence of +ALA tests, histories of pica, and histories of pica for paint than other ethnic groups by their life-time exposure to poorer housing and its attendant hazards. Finally, the survey team found extremely widespread sale and use of lead based paint, indicating that the current state and local laws are ineffectual in restricting the use of this paint.

95. **Pica and lead poisoning**—Guinee V.F., Bur. of Lead Poisoning Control, New York City Dept. of Hlth, New York, N.Y.—NUTR. REV. 1971, 29/12 (267-269)

Lead poisoning is most prevalent among black children in older cities in the US. At least 100,000 children are affected and pica is an important factor in the cause. Paint put on 50 years ago remains toxic even though 20 new coats have been applied. In 3 or 4 months a steady diet of 3 mg. of lead can raise the serum level significantly. In young children, the habit of eating paper, paint and dirt seems to amount to the earliest addiction. The problem in New York is enormous so that house repair, venous blood screening and health education were started in 1970. The 'pica balloon', a 30 second spot TV announcement, has been broadcast hundreds of times on television in New York. Three per cent of the children city-wide had lead levels in the serum of 60 μg. or higher. Substandard housing is the main fault and eradication of this will solve the problem.

96. Controlling pica via an environmental-psychobehavioral strategy: with special reference to lead poisoning—Woody R.H., Psychobehavioral Inst. for Hum. Resources, Grandville, Mich.—J. SCH. HLTH 1971, 41 (548-549, 552-555)

Existing theories of pica, namely that pica is due to a nutritional deficit or a psychosexual emotional conflict, have not been validated, and there is reason to believe that a third etiological theory, aligned with behaviorism, might be equally justifiable. Treatment of the pica child and especially children who have ingested significant amounts of lead-based materials have been relatively ineffective. Moreover, certain elements of the crisis-oriented approach to the treatment, from the exaggerated effect of both parents and professionals to the physical rennovation of the child's home environment (supposedly to eliminate the possibility of further lead poisoning), could serve to reinforce the pica behavior (particularly if the hypothesized psychosexual elements are present) and thus might actually be deleterious actions. It would appear that behavioral modification techniques have been too long bypassed in the treatment of pica, and that the most appropriate treatment would be an integrated environmental-psychobehavioral approach.

97. Absorption and excretion of lead in gasoline burns—Wood McD., Price W.R., Childers D. and Cook F., Dept. of Surg., Maricopa County Gen. Hosp., Phoenix, Ariz.—AMER. J. SURG. 1968, 116/5 (622-626)

Of 163 persons burned by flame, there was a greater mortality when injury was by gasoline flames (29%) than by nongasoline flames (16%). Urinary lead and coproporphyrins were measured in 18 persons thermally burned by gasoline. The levels were elevated above the normal or safe limits in 14. Gasoline, with tetraethyllead and tetramethyllead, contains a significant amount of lead. Absorption of lead is unlikely through the intestinal tract, possibly through the respiratory tract from combustion products, but most probably through the burned surface. Biopsy of the eschar indicated persistence of lead in the burned surface. This is a possible continuing source of absorption long after the initial exposure. In the treatment of gasoline burns it is suggested that, with the finding of lead within the burn eschar initially and for many days after the burn occurred, early removal of the eschar would reduce the source of lead. The detriment of extensive debridement must be weighed against the potential hazard of lead, and excision will require sound clinical judgment. An increased lead excretion was observed when an increase in urinary volume occurred. It would be logical to assume that maintaining an adequate urinary output would provide improved lead excretion. Although acute lead absorption, poisoning, and encephalopathy are difficult to define, it is speculated that levels of lead higher than normal in the tissues and in the urine of a burned person may contribute to the morbidity and mortality.

98. Earthenware containers as a source of fatal lead poisoning. Case study and public-health considerations—Klein M., Namer R., Harpur E. and Corbin R., Dept. of Ped., McGill Univ., Quebec—NEW ENGL. J. MED. 1970, 283/13 (669-672)

Two young children suffered lead poisoning as a result of drinking juice stored in a modern handmade earthenware jug. One of the children died. Subsequent testing of 264 contemporary earthenware glaze surfaces revealed that 50% released sufficient lead to make them unsafe for culinary use. Between 10 and 25% of the pieces tested would have been capable of causing severe lead poisoning. Compounding of safe earthenware glazes is essential.

99. Mercury in the marine environment—Klein D.H. and Goldberg E.D., Scripps Inst. of Oceanography, La Jolla, Calif.—ENVIRONM. SCI. TECHNOL. 1970, 4/9 (765-768)

A survey of the literature in respect to the production, consumption, release and dispersion of mercury shows that these factors are influenced not only by humans, but also by other members of the biosphere. Mercury is concentrated more highly in marine organisms than in seawater, thereby causing increasing levels with depth in the water column, a situation also known for other elements involved in biological cycles. To extend the present knowledge about mercury in the marine environment a study was undertaken in which analyses were carried out on the soft parts of 81 marine organisms, most of which were epibenthic fauna, and on 16 samples of marine sediments collected at varying distances from a sewer outfall. The following findings were recorded: Mercury levels in sea animals appear to be 500 or more times greater than those in comparable volumes of sea-water, assuming the living organisms contain 90% water by weight. The differences within the same species were the same as or greater than differences in content between different organisms. The mercury level in the organisms near the sewer outfall were comparable to those far removed. However, near the outfall the mercury content of sediments was as much as 50-fold higher than presumably uncontaminated sediments further away, thereby implying the human influence on the marine environment. It is therefore concluded that industrial and agricultural dispersion of mercury compounds involves organisms by their ingestion of compounds of this element or of the element itself. Pollution studies involving mercury may benefit from the identification of indicator organisms in diagnosing the human influence on the environment.

100. Maximum daily intake of lead without excessive body lead-burden in children—King B.G., Bur. of Commun. Environm. Management, Publ. Hlth Serv., Cincinnati, O.—AMER. J. DIS. CHILD. 1971, 122[illegible]40)

Three hundred microgra[illegible] elemental lead is considered to be the maximum daily permissible intake (DPI) from all sources for children. As the average intake increases above this value, the entire amount cannot be excreted and accumulation in the body begins. This will increase progressively as long as undue ingestion continues. The DPI has been established on the basis of levels of lead in the blood of nonexposed and exposed children including those with frank lead poisoning; results of experimental lead ingestion by adults; fecal lead output in children; initial biologic effects of increased lead intake; rates of increase in lead in the blood of exposed children; and sequelae of lead poisoning. The aim of the DPI is prevention of disease and preservation of health in children.

101. Pink disease—Jenner G.G.—N.Z. MED. J. 1966, 65/411 (802-803)

A case of pink disease in a baby of 38 weeks who presented with extreme crossness, poor appetite and failure to gain weight is described. He had had eczema of the scalp for 2 months which was being treated with an ointment containing 3% ammoniated mercury. He was found to have a fine rash on his body with red, cold, peeling hands and feet and photophobia. He responded slowly to general care.

102. Minamata disease / Minamata-sjukan—Berglund F.—LÄKARTIDN. 1967, 64/36 (3531-3539)

Between 1953 and 1960 a number of cases of poisoning with methyl mercury was observed in the region of the Minamata Bay of Japan. It was found that the poisoning was caused by consumption of fish and shellfish contaminated by chemical waste. All age groups, particularly children under 10 years, were affected. The Minamata disease gave rise to a variety of CNS symptoms depending on the severity of the intoxication, which in the acute form proved fatal within about 2 months. Autopsy showed the pathological changes to be localized exclusively in the brain, particularly the cerebellum, but also the occipital and temporal lobes. No specific changes were observed in the spinal marrow or peripheral nerves, and no changes in the optic nerve or retina were observed even in cases with severe visual disturbances. The mercury content of liver, kidney and brain were markedly elevated in these patients, but considerably lower levels were observed in cases of intrauterine methyl mercury poisoning. Cases of this nature had occurred even when the mother was only slightly affected or symptom-free. High mercury content was demonstrated in the wash of the Minamata Bay near the industrial outlet and, in experimental animals, shellfish from this site gave rise to a symptomatology similar to that observed in humans. Data from animal experiments have shown the similarity between the symptoms of experimental alkyl mercury poisoning and the Minamata disease. Certain differences were observed however between the clinical manifestations of this disease and those of 331 cases of alkyl mercury poisoning observed in Iraq within the period 1956-1960, possibly because of a different body distribution of the 2 mercury derivatives involved. The mercury content in fish from various parts of Sweden has in some cases been found to be high. Since Sweden, like Japan, has families with a seasonal daily consumption of fish, there could also be a certain minimal risk of methyl mercury poisoning. Warning against consumption of fish with a mercury content about 1 mg./kg., particularly by pregnant women and young children, has been issued by the Swedish public health authorities.

103. The effects of heavy metals (other than mercury) on marine and estuarine organisms—Bryan G.W., The Lab., Citadel Hill, Plymouth—PROC. ROY. SOC. LOND. 177/B (389-410)

Heavy metals such as copper, zinc and lead are normal constituents of marine and estuarine environments. When additional quantities are introduced from industrial wastes or sewage they enter the biogeochemical cycle and, as a result of being potentially toxic, may interfere with the ecology of a particular environment. In different marine organisms, the behavior of heavy metals is described in terms of their absorption, storage, excretion and regulation when different concentrations are available in the environment. At higher concentrations, the detrimental effects of heavy metals become apparent and their different toxic effects and factors affecting them are also described.

104. Lead concentrations in human tissues—Barry P.S.I. and Mossman D.B., The Associated Octel Co. Ltd., London—BRIT. J. INDUSTR. MED. 1970, 27/4 (339-351)

A study of 69 subjects at post-mortem, 4 of whom had histories of occupational exposure to lead, demonstrated a marked difference in the lead concentrations between bones and soft tissues. The soft tissues of infants and young children contained low concentrations of lead, varying from 0-01 ppm in muscle to 0-46 ppm in liver. By the end of the second decade of life the concentrations of lead in most of the soft tissues showed values varying between 0-06 ppm in muscle and 1-35 ppm in liver and thereafter did not increase with advancing age. The concentrations of lead in bone were considerably greater than those in the soft tissues, being about 1 ppm in infants and young children and increasing to more than 40 ppm in persons over the age of 50 years. Adult male bones contained more lead than adult females by a ratio of 3 to 2, and in both sexes the long bone contained concentrations of lead two and a half times that observed in the flat bone. No marked difference was noted in lead concentrations between the corresponding soft tissues of the 2 sexes. From the findings it appeared that in adults the total body burden varied widely from subject to subject. Nearly 95% was represented by the lead content in bone, of which more than 70% was in dense bone. A far lower concentration of lead was found in the bones of children than in those of adults, but there was less divergence in the lead concentrations in the soft tissues. The total lead content in the soft tissues of the majority of the subjects investigated appeared to be relatively stable and did not correlate with levels in bone. The 4 men with known occupational exposure to lead had greater concentrations of lead in bone than those with no known occupational exposure, but no difference was noted in the soft tissues between the 2 groups, with the exception of the most heavily exposed subject in whom concentrations of lead in the brain were over 4 ppm and in the aorta 28 ppm. Hair and nails were found to contain relatively high concentrations of lead, approximately 20 ppm; some significance may be attached to this finding in a medico-legal context. The findings of this study would suggest that the present intake of lead among the general population is no greater than in the past.

105. Copper, zinc, cadmium, and lead in human blood from 19 locations in the United States —Kubota J., Lazar V.A. and Losee F., Soil Conserv. Serv. and US Plant, Soil and Nutrit. Lab., Agricult. Res. Serv., Ithaca, N.Y.—ARCH. ENVIRONM. HLTH 1968, 16/6 (788-793)

Copper, zinc, cadmium, and lead were determined in 243 blood samples of male residents of 19 cities in the continental US. The mean copper and zinc concentrations of all samples agreed closely with values reported by other investigators. The means among the 19 locations, however, differed by 3-fold in copper and 5-fold in zinc. The levels of copper and zinc in blood in 17 locations were normally distributed about their means except in 2 locations. Unlike copper and zinc, the concentrations of cadmium and lead varied widely among samples from a given location.

106. The hygienic evaluation of baby powders / Ocena higieniczna zasypek dla dzieci—Krechniak A., Kat. i Zakł. Hig. AM, Gdansk—PEDIAT. POL. 1969, 44/3 (325-328)

A hygienic evaluation of baby powders produced in Poland was made. The evaluation was based on determination of the content of arsenic, copper, lead, starch, stearates and on determination of the degree of dispersion. In all powders the test for stearates was negative, starch was present in one powder only. The contents of arsenic, copper and lead were within admissible limits. The determination of the degree of dispersion showed that the amount of powder remaining on a normalized sieve did not exceed the accepted normal value.

107. Community aspects of lead intoxication in children—Charest S., Cohen G.J., Lourie R.S. and Anderson D., Comprehensive Hlth Care Clin., Child. Hosp., Washington, D.C. CLIN. PROC. CHILD. HOSP. (WASH.) 1969, 25 (308-319)

Cultural problems rather than malnutrition accounts for pica and also the risk of lead poisoning. Discipline from the mother is bound to be inadequate in this respect. It is easy in 3 months for a 30 lb. child to ingest a lethal amount of lead from paint flakes containing lead. In addition to the blood, bone, brain and kidney toxicity, arrhythmias may result - suggesting myocardial change. The arbitrary blood lead level of 60 μg./100 ml. is an indication for treatment at a lower level. A 24-hour urine level of 80 μg. is suspicious, and a 10-fold increase after one dose of EDTA confirms this. X-rays may show opaque paint-chips in the intestine and transverse lines of increased density in the ends of the long bones. Social workers reinforce the prophylactic message: pica does not usually continue after the age of 5 years and when associated with lead poisoning, it is a man-made illness.

108. Chronic lead intoxication mimicking motor neuron disease—Campbell A.M.G. and Williams E.R., Bristol United Hosps, Bristol—BRIT. MED. J. 1968 (582)

The authors report that a survey of cases of motor neuron disease in Britain showed that 17% had a history of known contact with lead. The motor neuron system disease, however, shows itself long after actual exposure to the lead. A woman who had handled lead 10 years previously presented with motor neuron weakness but improved considerably on treatment with calcium versenate. The improvement had continued but she still shows some motor disability. A severe case of motor neuron disturbance occurred in a farmer who had been treated 25 years earlier for acute lead poisoning from contaminated cider, and a clergyman developed the disease 10 years after painting his church with white lead. The final cause of motor neuron disease remains unknown but genetic, viral, deficiency and toxic factors may all play a part in disturbing enzyme function at a cellular level. An investigation is being made into the etiological factors in motor neuron disease.

109. Lead in mentally retarded children—Bicknell J., Clayton B.E. and Delves H.T., Queen Mary's Hosp. for Children, Carshalton, Surrey—J. MENT. DEFIC. RES. 1968, 12/4 (282-293)

From a population of hospitalized severely subnormal children in long-term care, 3 groups were selected: (a) with pica, (b) physically handicapped without pica and (c) mobile children without pica. Excessive ingestion of lead by approximately 70% of subjects in the 'pica' group was shown from a study of blood lead levels and the urinary lead excretion in response to oral calcium EDTA. There was no evidence that moderately raised blood lead levels had any relationship to the original cause of the mental retardation. Pica appears to be more common in the disturbed retarded child and may be both selective and highly motivated even with a low mental age. The oral calcium EDTA-lead excretion test with random specimens of urine appears to be safe and free from unpleasant side effects. It may be a useful supplement to blood and urine lead levels when equivocal results have been previously obtained.

110. Childhood lead poisoning: a major urban health problem—Christian J.R.—NEB. MED. J. 1969, 54 (677-682)

A review of lead poisoning in children is presented, covering historical, experimental, epidemiological, diagnostic and therapeutic aspects. It has been suggested that lead poisoning was a major factor in the degeneration, decay and fall of Rome. There are indications that residents of the US are undergoing severe chronic lead insult. Excessive lead absorption in childhood has been suggested as the nephrotoxic agent which was responsible for deaths from chronic nephritis in Queensland between 1870 and 1920. Experimental studies have shown lead to cause neoplasia in the rat, severe renal damage in the rat deficient in magnesium, and severe retinopathy and an interruption of the formation of osteoid and collagenous matrices in the rabbit. Diagnostic signs, symptoms and laboratory evidence of lead intoxication are listed. Epidemiological data collected by the Poison Control Center of the Chicago Board of Health in 1959-1964 show 926 cases of lead intoxication (4% of the total cases of accidental poisoning), 116 of them fatal (71% of the total mortality); pica was responsible for 62% of the reported cases; the highest incidence was characteristically higher during June-September; and the sex distribution was not significant. Observations on the 582 children treated for lead poisoning in 1967-1968 showed no significant changes in distribution compared to 1959-1964. The general plan for the management of children with lead intoxication, which was successful during the past 3 years in Chicago, is outlined. Each suspected patient is screened by urinary coproporphyrin and serum lead determinations: serum lead levels above 50 μg.% are considered significant, but the patient may or may not have symptoms. Evaluation of asymptomatic children includes complete history, physical examination and laboratory studies: if serum lead, on respected determination, is below 50 μg.% only follow-up is instituted, if it is 50-100 μg.%, treatment is probably indicated, and if it is above 100 μg.%, treatment is definitely indicated. The 5-day therapy includes administration of sodium calcium edetate or penicillamine; if the 1st course of edetate is ineffective, addition of dimercaprol may be indicated. Follow-up should include, in addition to a narrative description of clinical course, instructions to the parents and repeated blood lead determinations, inspection for possible building-code violations.

111. Lead in drinking water—Crawford M.D. and Morris J.N., MRC Soc. Med. Res. Unit, London Sch. of Hyg. and Trop. Med., London—LANCET 1967, 2 (1087-1088)

Preliminary reports on 2 studies undertaken to investigate the association between mortality from cardiovascular disease and softness of drinking water in Britain showed that there was no indication of an important excess of any likely metal contamination in any of the waters examined. Lead concentration was less than 0.1 ppm in all the samples except in one from a hard-water town, which had 0.1-0.2 ppm. The nature of the piping was not taken into account in these studies. Metal contamination from pipes at this level did not seem to be significantly involved in the association between cardiovascular mortality and softness of drinking water. It has, however, been suggested that the plumbosolvency may still be a problem in Britain and that the lead content of water lying in pipes overnight or longer might be dangerously high in some soft-water areas. A study was therefore undertaken in which overnight water samples were collected from 5-6 inhabited houses with lead piping in each of 18 large boroughs, 9 with soft and 9 with hard water, and analyzed for lead. The findings of this study indicated that there still is a plumbosolvency problem in Britain in water lying in contact with lead piping for some hours. The highest concentration of lead was in fact found in soft water, but lead value above the conventional safety standard (0.1 ppm) were observed also in hard waters. The possible variation in the lead content of tap water from house to house and from day to day should therefore be investigated and the facilities for the testing for plumbosolvency extended in some areas. Soft acid waters are potentially more dangerous, but the study demonstrated that certain hard waters may be plumbosolvent. The possible health implications of these findings should therefore be the subject of further consideration.

Clinico-pathological studies

112. A case of acute iron poisoning. Case report and contribution to the therapy of acute iron poisoning with the iron chelator deferoxamine B / Ein Fall von akuter Eisenvergiftung. Zugleich ein Beitrag zur Therapie der akuten Eisenvergiftung mit dem Eisen-Komplexbildner Desferrioxamin B.—Scherzinger F., Harrisburg Hosp., Harrisburg, Pa.—MSCHR. KINDERHEILK. 1966, 114/12 (596-597)

A 16-month-old girl ingested approximately 50 tablets of a commercial iron preparation containing 39 mg. per tablet of elemental iron. Initial examination revealed no remarkable findings. Vomiting was induced by syrup of ipecac. Subsequent gastric lavage produced only small fragments of tablets. Shortly afterward the child became confused and apathetic. Several thin tarry stools were passed. Serum iron values were 375γ%. An intravenous drip with 5% glucose and $^1/_3$N saline was started. Deferoxamine 5000 mg. was given by gastric tube. Every 4 hours 500 mg. of the same drug was administered injected intramuscularly. Within 12 hours the cardiocirculatory collapse improved to the point that the child was able to ingest liquid food. On the fourth hospital day the patient was discharged in normal clinical conditions. The clinical picture of acute iron poisoning is discussed. The main features are vomiting, diarrhea with tarry stools and ensuing hypovolemic shock. Confusion is an early symptom and may be followed by unconsciousness. Convulsions have been observed. Serum iron levels are closely linked to the severity of the clinical condition. Deferoxamine is the drug of choice. One gram is capable of binding 85 mg. of iron. Immediate administration of 8000 mg. should be given orally, followed by 2000 mg. by intramuscular or intravenous injection. Subsequent doses depend on the clinical condition of the patient.

113. Pink disease in Eastern Anatolia. A study of 15 cases of chronic mercury poisoning—Aksungur L. and Özcan N., Dept. of Dermatol., Ataturk Univ. Med. Sch., Erzurum—TURK. J. PEDIAT. 1969, 11/1 (18-27)

Twenty patients were examined who became ill from eating wheat seed which had been treated by fungicides containing mercury. Fifteen showed the presence of mercury in their urine. They were selected for a more complete study and were divided into 3 groups according to their symptoms. The symptoms and their implications for each group were discussed. It is believed that the symptoms of mercury poisoning depend upon the amount of mercury in the tissues, the age and the constitution of the individual. It was also found that acrodynia may occur in persons aged up to 18 years, and that hypertension is not commonly seen in this disease. One must be alert to the possibility of chronic mercury poisoning in Turkey, especially in areas where the population is forced to eat wheat seed because of a shortage of flour during the winter.

114. Embryopathy induced by aminopterin, kwashiorkor, ill treated child, congenital listeriosis and lead poisoning, leptospiral jaundice / Embryopathie de l'aminoptérine, kwashiorkor, enfant maltraité, listériose congénitale et saturnisme, maladie de Weil—Gautier E., Serv. de Péd., Hôp. Cant. Univ., Lausanne—SCHWEIZ. MED. WSCHR. 1969, 99 (33-40)

Among the unusual clinical pictures presented in the paper there is an interesting case concerning a child with congenital listeriosis which subsequently developed chronic plumbism. At birth, the child exhibited symptoms of congenital listeriosis. This diagnosis was corroborated by laboratory studies. Treatment with antibiotics and sulfonamides had a beneficial effect on the general physical condition but subsequently there developed marked psychomotor retardation. At the age of $4^3/_4$ years the child was hospitalized because of pain and swelling of several joints. Neurological examination was unremarkable, except psychomotor retardation and impairment of hearing. The EEG was normal. X-ray examination showed an abnormal density of the epiphyseal lines. Hemoglobin was 9.6 g.%. Obstinate constipation was present and flat films of the abdomen showed radiopaque metal fragments. These features should have raised the suspicion of plumbism. At the age of $5^1/_2$ years the child was again admitted to hospital with fever, arthritis in the lower limbs, anorexia and constipation. The density of the epiphyseal lines and the number of metal fragments in the bowel had considerably increased. Then the diagnosis of plumbism was entertained. On close questioning the parents stated that the child used to play with lead fragments in the workshop of his father and to mouth them. The family did not stop this habit as they were not conversant with the hazards involved. Additional examinations showed a moderate elevation of blood lead. Spinal fluid pressure was normal. No stippled basophil erythrocytes were found but belated search for these cells in the blood smears taken 9 months previously gave a positive result. Urinary lead levels were increased only in one sample. The remaining lead fragments were evacuated and a combined treatment with EDTA and dimercaprol was instituted. Side effects consisted of fever, vomiting and hypertension. After three cycles the blood lead levels returned to normal and there was considerable improvement in the general physical condition of the child. Measures were taken to avoid further exposure to lead.

115. A case of mercury poisoning: acrodynia in a child of 8—Alexander J.F. and Rosario R., Dept. of Gen. Pract., Regina Gen. Hosp., Regina—CANAD. MED. ASS. J. 1971, 104/10 (929-930)

A case of mercury poisoning in a girl of 8 years is described. She presented with a 4 weeks' history of irritability, sweating, generalized pains and an erythematous rash which had faded but was followed by an itchy vesicular eruption of the hands and feet. On admission she was very distressed, assumed the fetal position with limbs rigidly flexed and sweated profusely although her temperature was normal. Photophobia was not marked. Her serum and urine mercury levels were found to be raised. She responded rapidly to treatment with intramuscular dimercaprol. Her mother, father and 5 sisters were all found to have raised urinary mercury excretion but none of them showed symptoms of mercury poisoning. The source of the mercury was found to be a can of mercury taken home from school by one of the children of the family with which all the children had played daily.

116. The pathological picture of acrodynia / Zum Krankheitsbild der Akrodynie (Syndrom von Feer)—Schöne D., Wässer St. and Polster H., Kinderklin., Karl-Marx-Univ., Leipzig—KINDERÄRZTL. PRAX. 1970, 38/9 (390-397)

A variety of symptoms characterizes acrodynia. The disease is now rare and the diagnosis can be made only if the clinical picture is beyond doubt. The etiopathology, management and prognosis are discussed. A girl, aged 7, is described in whom acrodynia was complicated by rectal prolapse, attacks of apnea, extensive trophic disturbances (ulcerations, spontaneous fractures) and secondary infective lesions. Mercury from a defective dental filling was considered to have been the causative agent.

117. Damage from chronic mercury poisoning. A new variety / Über eine bisher nicht beachtete Möglichkeit chronischer Quecksilberschäden—Gädeke R., Univ.-Kinderklin., Freiburg i. Br.—ARCH. KINDERHEILK. 1966, 174/2 (107-111)

Chronic mercury intoxication in an 11 year old girl is reported. A striking local alopecia of the eyelashes and eyebrows was one of the main symptoms. The mercury originated from wooden masts serving as holders of electrical lines and drenched in sublimate. This child played among such masts. The wood was also used as heating material in her home.

118. Lead poisoning in children / Intossicazione da piombo nel bambino—Gelli G., Div. Ped., Osp. Civ., La Spezia—MINERVA PEDIAT. 1967, 19/33 (1570-1573)

A case of lead poisoning is described in a $2^{1}/_{2}$ year old girl who absorbed the poison through her lungs. The symptoms were not very severe and were partly revealed by an upper respiratory infection. The results obtained in this case combined the therapeutic effectiveness of not very large doses of EDTA and of the accessory use of prednisolone. A survey of the literature is presented.

119. Lead poisoning from home remedies—McNiel J.R. and Reinhard M.C., Dept. of Ped., Arabian Amer. Oil Co., Ras Tanura—CLIN. PEDIAT. 1967, 6/3 (150-156)

Ten cases of lead poisoning in children with lead-containing home remedies are reported from the hospital of an oil company in Saudi Arabia and 5 of the most instructive case histories are presented. In each case the source of lead was identified as a home remedy with a content of 90-98% of lead oxide. Since lead contaminated remedies may be used as treatment for other illnesses, the symptoms of these may obscure the diagnosis of lead poisoning. It is therefore advised that all children with unexplained convulsions should undergo a spinal fluid examination. In lead poisoning with encephalopathy spinal fluid protein as well as fluid pressure are usually elevated. The cell count is generally below 20 white cells per cu.mm with a predominance of lymphocytes, but may be higher and have more polymorphonuclear cells. Since viral meningoencephalitis presents similar findings, the possibility of lead encephalopathy should be ruled out in children with suspected viral encephalitis. Specific changes in blood, urine and long bones are observed in cases of lead poisoning. When available, blood lead level determinations are especially valuable. The current therapeutic recommendations are outlined as follows: Initially dimercaprol only in a dose of 4 mg./kg. body weight intramuscularly, followed after 4 hours and subsequently every 4 hours for 5 days by a combination of dimercaprol and CaEDTA given intramuscularly at different sites in the following doses: dimercaprol 4 mg./kg. body weight/dose and CaEdTA 12.5 mg./kg. body weight/dose. For a newborn the dose of CaEDTA may be reduced to 10 mg./kg. body weight. In some cases it may be advantageous simultaneously to clear the bowel of lead with saline enemas.

120. Lead poisoning in childhood in Ceylon—Mirando E.H. and Gomez M., Lady Ridgeway Child's Hosp., Colombo—ARCH. DIS. CHILDH. 1967, 42/226 (579-582)

A series of 12 cases of lead poisoning in children in Colombo is reported. In addition to the sources of lead which are generally recognized, in 6 cases the source was traced to the fact that the children were living in premises where small-scale gold recovery from jeweller's wastes was carried out. Inhalation of lead-containing fumes was a feature in many of the cases.

121. Lead encephalopathy in children. Uncommon clinical aspects—Mirando E.H. and Ranasinghe L., Lady Ridgeway Hosp. for Children, Colombo—MED. J. AUST. 1970, 57 (II)/21 (966-968)

Three cases of lead encephalopathy (from a series of 24) are reported in order to draw attention to the unusual features: acute communicating hydrocephalus, tremors and visual failure. Views on the pathogenesis of hydrocephalus in lead poisoning are discussed. Emphasis is laid on the need for recognizing the uncommon manifestations for early diagnosis of childhood plumbism.

122. Erythrocyte hypoplasia due to lead poisoning. A devastating, yet curable disease—Moosa A. and Harris F., Dept. of Child Hlth, Univ. of Sheffield—CLIN. PEDIAT. 1969, 8/7 (400-402)

Heavy-metal intoxication in children still occurs as illustrated by the case history of a 3-year-old boy who was admitted with an unusually severe anemia. The diagnosis of lead poisoning suggested by pallor and abdominal pain was confirmed by both increased blood lead levels and the increased urinary lead excretion following a CaEDTA diagnostic test. The absence in this case of diagnostic criteria such as basophilic stippling, 'lead lines' on X-rays of long bones and coproporphyrinuria has also been reported elsewhere. However, the unusual and significant feature of this patient was his severe anemia and erythrocyte hypoplasia of the bone marrow, which differed from the usual description in standard textbooks. This finding may have been the result of a nonregenerative phase following hemolysis and both anomalies due to the toxic agent. The absence of basophilic stippling may have been due to erythrocyte hypoplasia. Since it has been suggested that stippled cells are reticulocytes in which basophilic material is altered by lead, the presence of stippled cells may be a measure of erythroid regeneration. In the patient in question, stippled cells were only observed after therapy with CaEDTA when marrow regeneration had occurred. Erythrocyte hypoplasia is a serious condition in childhood with poor prognosis and the possibility of lead intoxication should therefore always be considered in the differential diagnosis of cases of this nature. Blood lead level determination will establish the diagnosis and adequate treatment with chelating agents usually resolves the erythrocyte hypoplasia of the bone marrow.

123. Lead hazard in artisans and their families with the description of chronic lead poisoning in a child / Narazenie na dzialanie olowiu rzemieślników i ich rodzin z opisem przewleklej olowicy u dziecka—Salwa S. and Wójcik T., Wojewodzk. Spec. Szpit. Dziec., Kielcach—MED. PRACY 1966, 17/1 (57-63)

A case of chronic lead poisoning is described in a child whose family had a pottery workshop in the home. Symptoms of lead poisoning were also found in the parents. The authors determined the number of erythrocytes with basophilous granulations, as well as coproporphyrin and lead levels in the urine of 13 other persons employed in making earthenware. As the examinations gave evidence of the considerable occupational hazard in home production of pots, sanitary supervision and medical protection of all pottery workshops, as well as the family members is considered a necessity. Glazes containing boron compounds are recommended as a substitute for lead glazes.

124. Chronic encephalopathy in lead poisoning / L'encefalopatie cronica da piombo—Romano C., Tortorolo G., Grossi-Bianchi M.L. and Verde J., Clin. Ped. 'G. Gaslini', Univ. di Genova—MINERVA PEDIAT. 1966, 18/8 (416-425)

The aim of this paper is to show that lead poisoning in children produces a chronic disorder characterized by regression and mental retardation rather than acute hypertensive encephalopathy. In 1960, White and Fowler in the US described 2 cases with psychomotor disturbances and severe behavioral disorders. The present authors suggest that a new syndrome can be described on the basis of these 2 cases and a third that they have themselves observed, comprising aphasia, peculiar character changes, and psychomotor regression. The boy was first seen at the age of 15 months for 'toxic symptoms' (dyspepsia and urticaria) which the mother attributed to eating paint. At 18 months he was again seen with similar symptoms, and at 2 years 11 months, the mother reported regression in his psychomotor development, disturbances in his character and behavior, and temper tantrums. In the previous fortnight he had vomited, with slight fever, loss of appetite, abdominal pain and enuresis; he had also had attacks of falling or throwing himself on the ground. The child made neurological examination difficult. He was given a detailed physiological examination and was tested for general mental and speech development. The tests showed sensory aphasia with severe amnesia. His spontaneous speech was a year behind the average. His IQ was 74. The boy's mental deficiency was ascribed to encephalopathy of an unspecified nature, but X-rays of the joints demonstrated signs of lead poisoning. There was no sign of acute hypertensive encephalopathy and chelators led to a striking improvement, with a rise in his IQ to within normal limits. In this case there was no microcytic anemia or glycosuria with a normal blood-sugar, which are the usual diagnostic criteria of lead encephalopathy. The diagnosis was based on the history, the transverse bands of metaphysial bone thickening in the X-rays, the high blood-lead level, and the above-average urinary coproporphyrin. The diagnosis was confirmed by the success of treatment with the chelators, calcium-EDTA or sodium-EDTA, given intravenously every 2 hours for 4 days, with 4 days' interval between courses. In a case where chelators were not given, progress was much slower.

125. Aphasia and dementia in childhood chronic lead encephalopathy: a curable form of acquired mental impairment—Romano C. and Grossi-Bianchi M.L., Dept. of Ped., Univ. of Genoa—PANMINERVA MED. 1968, 10 (448-450)

A 3-year-old child with chronic lead encephalopathy presenting as mental deficiency and speech delay is discussed. A diagnosis of lead poisoning was made on a history of exposure, recurrent gastroenteritis and skin eruptions, and confirmed radiologically and by estimations of blood lead, urinary coproporphyrins, and the EDTA test. There was neither basophilic stippling nor lead line. There had been language delay, recent mental deterioration, and behavior changes. Neurological examination was normal; there were slight abnormalities in the EEG with irregular slowing and spiking in temporal areas. Psychometric examination gave a diagnosis of aphasia, mainly receptive, and dementia. EDTA treatment was begun, 4 courses being given. Subsequent examination showed resumption of mental development with diminution of aphasia and behavior disorders. EEG returned to normal. By 1 year after treatment, IQ, language and behavior were all within normal limits. The sparse literature on chronic lead encephalopathy without signs of increased intracranial pressure and with essentially psychological symptoms is reviewed. The importance of recognition of the syndrome emphasized.

126. Uncommon differential diagnoses from suspected tuberculous spondylitis in early childhood / Seltene Diffential diagnosen zum Spondylitis-tbc.-Verdacht im Kleinkindesalter—Tietz H., Orthop. Abt., Univ. Kinderklin., Greifswald—Z. ORTHOP. 1966, 101 (514-517)

Two cases are reported where the suspected diagnosis of spondylitis tuberculosa seemed to be confirmed. During the course of observation the 14 month old girl was found to have an intramedullar tumor (oligodendroglioma-spongioblastoma). The second case, a $2^1/_2$ year old boy, was found to have Feer's disease (infantile encephalopathy), induced by mercury intoxication. In both children, the immediate 'classical' therapy of spondylitis, *i.e.* rest in a long cast-bed, positively influenced the algesic symptoms. According to the basic disease, the girl with the inoperable glioma died after 16 months (from the manifestations of the first symptoms), while the boy with Feer's disease was cured within 6 months.

127. Encephalopathy in chronic lead poisoning (Greek)—Anastassea-Vlachou P., Benetou S. and Mandalenaki-Asfi E.—DELT. PAIDET. KLIN. PANEP. ATHIN. 1968, 15/3 (250-267)

Encephalopathy due to chronic lead poisoning is described in a 9 month old girl. A short review of the pertinent literature is given.

128. Lead poisoning in children—Bapat V.R.—HARPER HOSP. BULL. 1968, 26/1 (34-39)

This paper reviews the cause, diagnosis, and treatment of lead poisoning, and includes an illustrative case report. Early diagnosis is necessary in order to lessen danger of mental defect or death. Most frequent clues to this malady are stippling of the erythrocytes and hypochromic microcytic anemia. Blood lead levels range from 0.04 to 0.06 mg.%. Removal of lead from soft tissues may be effected by treatment with Ca-EDTA. Paraldehyde is useful for convulsions, with sodium amytal reserved for intractable cases.

129. Neurological symptomatology in cases of chronic mercury poisoning in children / Symptomatologia neurologiczna w przypadkach przewleklego zatrucia rtecia u dzieci—Gościńska Z., Bartoszewicz B. and Piasecka M., Inst. Ped., II Klin. Chorób Dzieci, Kraków-Prokocim—PEDIAT. POL. 1967, 42/3 (297-303)

Three cases of chronic poisoning with mercury compounds in children with predominating neurological symptoms are described. In a $4^1/_2$-year-old boy signs of cerebral and cerebellar cortical damage (typical for Minamata's disease) were observed after poisoning with a fungicide used in agriculture called Fungitoks. In a girl aged $2^1/_2$, in whom a mercury skin ointment was used for a long time, acrodynia was diagnosed together with polyradiculoneuritis with cell-protein divergence in the cerebrospinal fluid. In a $3^1/_2$-year-old girl there were slight skin changes and severe neurological changes; tremor, muscle hypotonia, lack of reflexes and mental disturbances. Only after giving dimercaprol was excess mercury excretion in urine noted. The girl had previously used a mercury ointment and had contact with Fungitoks.

130. Acute iron poisoning. Clinical and laboratory observations with deferoxamine—Gevirtz N.R. and Rausen A.R., Dept. of Hematol., City Hosp. at Elmhurst, Mt Sinai Hosp., New York, N.Y.—J. MT SINAI HOSP. 1966, 53/1 (64-68)

A child with acute iron toxicity, due to the ingestion of 1.26 to 2.10 g. of iron as ferrous sulfate, had a rapid and favorable response to deferoxamine therapy. The rapidity of the response can be explained by deferoxamine's high stability constant for iron, by the rapid *in vivo* distribution of deferoxamine, and by low toxicity of iron which is bound to deferoxamine. A method for the determination of the total iron in serum containing deferoxamine is described.

131. Chronic lead poisoning in children: A review of 90 children diagnosed in Sydney, 1948-1967. 2. Clinical features and investigations—Freeman R., Dept. of Paed., Prince of Wales Hosp., Sydney—MED. J. AUST. 1970, 1 (648-651)

The distribution of lead in the body and the disturbance in porphyrin metabolism in lead intoxication are described. The clinical features of 90 children with chronic lead poisoning diagnosed in Sydney between 1948 and 1967 are discovered. Early symptoms were vague and mainly gastro-enterological or neurological. Anemia was frequent, but often absent early on. Encephalopathy, the most serious result of chronic lead poisoning, occurred in more than half of the children. It was often the mode of presentation, sometimes precipitated by an infection, but minor symptoms tended to precede encephalopathy for months in some cases. The investigations of these children are described, and it was notable that many of the accepted diagnostic tests gave negative results. The urinary lead excretion was found to be more reliable than the blood lead level as a parameter of lead intoxication. In a number of doubtful cases, the increased excretion of lead after administration of calcium EDTA was valuable in establishing the diagnosis.

132. **Acute, lethal poisoning after ingestion of metallic lead**—Forsby N., Fristedt B. and Kjellman B., Dept. of Occupat. Med., Univ. Hosp., Lund—ACTA PAEDIAT. SCAND. 1967, Suppl. 177 (107)

A previously healthy 2-year-old girl was admitted to hospital with vomiting of 10 days' duration. She had normal stools, normal temperature and no catarrhal symptoms. She was pale and lethargic. The muscle tone was slightly increased and her neck stiff. She had spontaneous vertical nystagmus and normal optic disks. Hemoglobin was 9.4 g./100 ml. Stippling of the red cells was noted (299/10,000 counted cells). White cells were 15,600 cmm. with a normal distribution. Serum electrolytes and glucose were normal. There was no albuminuria and urinary sediment was normal. Analyses of cerebrospinal fluid disclosed 0 red cells, 7 white cells, 73 mg./100 ml. protein and 83 mg./100 ml. glucose. EEG showed a slow background activity, but no focal abnormalities. Inquiries about medicines and poisons were negative. The girl died 24 hours after admission. At postmortem examination a lead button with a diameter of 22 mm. was found lying free in the stomach. The brain showed edema with signs of increased intracranial pressure and herniation. There were multiple subependymal petechial hemorrhages in the third ventricle. Microscopic examination revealed tiny cortical micro-infarcts with disappearance of some neurons and glial proliferation. The parenchymatous organs showed toxic changes. No 'lead line' was found in the gingivae. X-ray of the femur revealed no deposits in the epiphyses. The following tissue concentrations of lead were found; brain: 0.69 mg./100 g., liver: 5.4 mg./100 g. and kidney: 3.0 mg./100 g. In relation to corresponding figures in the literature these values are extremely high. The button was of a type used as curtain weights in the girl's home and still available in the shops. Children can easily swallow them and if caught in the gastrointestinal canal they can cause severe lead poisoning.

133. **Acute basophil myelocytic leukemia with skin and bone signs resembling lead poisoning in a young child / Leucémie aiguë à basophiles avec signes cutanés associée à des signes osseux évoquant un saturnisme chez un jeune enfant**—Teillet F., Weisgerber C., Meyer B. and Vialatte J., Inst. de Rech. sur les Maladies du Sang, Hôp. Saint-Louis, Paris—ANN. PEDIAT. (PARIS) 1970, 17/8-9 (543-550)

The authors report the case of a 5 year old boy with acute myelocytic leukemia, proliferation and maturation of basophil polymorphs, the granules being present not only in the latter but also in the eosinophil and neutrophil polymorphs. This leukemia is accompanied by a skin rash resembling erythema multiforme and coinciding with the multiplication of basophil cells. The course lasted 2 years without any of the various treatments causing a true remission. The disease ended in acute undifferentiated leukemia with disappearance of the skin signs. The probable relationship between the basophils and the skin lesions was difficult to prove. Finally the presence of skeletal abnormalities very different from the usual bony lesions in leukemia but resembling lead poisoning suggested the chance association of chronic lead poisoning.

134. Congenital and familial iron overload—Vitale L., Opitz J.M. and Shahidi N.T., Dept. of Ped., Univ. of Wisconsin Med. Sch., Madison, Wisc.—NEW ENGL. J. MED. 1969, 280/12 (642-645)

Two infants with hypotonia and minor congenital anomalies were found to have a striking increase in the total body iron in the absence of any hemolysis or unusual iron intake. The increase in iron was demonstrated histochemically and also by direct tissue iron determination. The absence of hemolysis and exogenous iron intake suggested a disturbance of iron transfer *in utero*. The presence of iron overload in both infants with similar clinical and pathological findings indicated that this condition is probably genetically determined.

135. The Children's Hospital Medical Center, Boston, Mass.—Farber S. and Vawler G.F.—J. PEDIAT. 1968, 68/3 (480-487)

A 15-month-old boy was admitted to hospital because of increasing weakness and a morbilliform rash. He had episodes of sweating and examination showed proteinuria and hematuria. Given prophylactic doses of oxytetracycline and a diet with added salt, he improved slightly. Further improvement followed the administration of 0.6 g. Versene intravenously for 3 days. When irritability, lethargy and hyporeflexia increased he was given a second course of Versene but this failed to produce further improvement. On the 13th day he had a temperature of 102°F and signs of shock. In spite of salt administered intravenously and 250 cc. whole blood, he died 9 hours later. The child presented a clear symptomatological study of acrodynia (pink disease) with characteristic skin changes, although erythema was absent. The morbilliform rash and autonomic nervous system involvement found were typical. Excessive water loss made an important contribution to the death. Renal changes of a salt-losing type were part of the picture. Urine examination on the third day in hospital showed a mercury level of 334 g./l., suggesting mercury poisoning but no source of mercury could be traced. In the course of discussion attention was called to the similarity of the clinical picture in this case to adrenal overfunctioning of the medulla and cortex. Comments were also made on possible sources of mercury, including ointments, toys, teething powders, and water-based paints.

136. Neurologic sequelae of plumbism in children—Perlstein M.A. and Attala R., Child.'s Neurol. Serv., Cook County Hosp., Chicago, Ill.—CLIN. PEDIAT. 1966, 5/5 (292-298)

Among 425 children with plumbism, 39% had neurologic sequelae. Mental retardation and recurrent seizures are most common and persist in approximately 1 out of 5 patients. Cerebral palsy and optic atrophy occur less frequently and are limited to those who present with either encephalopathic or ataxic syndromes. Cerebral palsy is usually of the spastic hemiplegic type. A patient who developed dystonia musculorum deformans is unique in the authors' experience. The younger the child and the more fulminating the onset, the greater the incidence of sequelae. In children presenting with severe encephalopathy, sequelae persist in over 4 out of 5. In those who present with seizures without increased intracranial pressure, sequelae occur in 2 out of 3. When ataxia is the only neurologic presenting symptom, sequelae occur in 3 out of 5. In those in whom the presenting symptoms are gastrointestinal, sequelae occur in less than 1 out of 3. When the onset is with a fever only, or asymptomatic, the incidence of sequelae is 1 out of 5 to 10. The nature and incidence of sequelae seem to be unrelated to the type of treatment employed.

137. Aspects of lead absorption in hospitalised psychotic children—Oliver B.E., Chelmsley Hosp., Marston Green, Birmingham—J. MENT. DEFIC. RES. 1967, 11 (132-142)

This is a report of 2 years of observations on aspects of lead metabolism of children showing psychotic features, in long term hospital care. The following observations were made. Sunny and/or warm and/or dry weather appears to be associated with a rise in blood lead. An attempt to reduce the amount of environmental lead produced an apparent reduction in the incidence of raised blood lead, although there are considerable reservations to this observation. There was a general lowering of hemoglobin level in relation to raised but still relatively low blood lead levels. Basophilic stippling was rare and lead lines in gums and paresis were not observed. Those children prone to have raised blood leads required about 3 to 4 months for their blood leads to rise 30-40 μg./100 ml. after they had been reduced by treatment. Penicillamine was effective in reducing blood lead in most cases. Toxic effects on the kidney from the raised blood leads or penicillamine were not observed. There was an overall reduction in the incidence of radiological evidence of lead deposition within the period of the study. However, abdominal X-rays continued to show evidence of ingestion of lead-containing substances.

138. Fine structural changes in human lead encephalopathy—Raimondi A.J., Beckman F. and Evans J.P.—TRANS. AMER. NEUROL. ASS. 1966, 91 (322-323)

Biopsy specimens from white matter and gray matter were removed from 6 children suffering from proven lead encephalopathy. Their clinical status varied from status epilepticus to deep coma with episodes of respiratory arrest. In the gray matter the most obvious changes were in the neurons with distension of the lamellar components of the granular ergastoplasm. There were changes compatible with swelling in the glial elements. The capillary endothelium of the gray matter showed the most obvious changes. The changes in the capillary endothelium in the white matter were insignificant. The most prominent changes in the white matter were in the extracellular space with extensive opening in correspondence to the pericapillary area and the area intervening between glial cells, cell processes and myelinated axons. There was swelling of the glial cells. The granular ergastoplasm distension was more obvious than that noted in the Golgi apparatus. Exhaustion phenomenon of the nuclei of the glial cells was common. There was splitting and delamination at the level of the intraperiod line within the myelin sheaths. The axonal changes consisted of a loss of neurofilaments and their replacement by diffuse granular looking material.

139. Lead poisoning from drinking soft water—Bacon A.P.C., Froome K., Gent A.E., Cooke T.K. and Sowerby P.—LANCET 1967, 1 (264-266)

Three cases of lead poisoning are described, in one of which the diagnosis had been missed for 12 years. In each instance the cause was long-term ingestion of soft water which had eroded lead from the inside of lead pipes bringing water to their houses.

140. Acute iron poisoning: assessment of severity and prognosis—James J.A., Children's Div., Los Angeles County-Univ. of Southern California Med. Cent., Los Angeles, Calif.—J. PEDIAT. 1970, 77/1 (118-119)

Sixty-six children with iron poisoning were studied. They were admitted to a pediatric inpatient service from 1965 to 1968. Seven children did not develop symptoms. Eighteen patients were considered mildly poisoned with vomiting and 1 or 2 loose stools. Those with vomiting and loose stools but without lethargy or shock were considered moderately poisoned (12 patients); and those with symptoms of vomiting, diarrhea, and lethargy, with or without shock, were considered severely poisoned (29 patients). Of 17 patients who were believed to have ingested fewer than 10 tablets of ferrous sulphate only 3 were considered severely poisoned; of 17 patients who had ingested 20 or more tablets all were symptomatic and 15 were moderately or severely poisoned. Fifteen of 20 patients with admission serum iron concentration in excess of 500 μg./100 ml. were considered moderately or severely poisoned. Only 4 of 13 patients with concentrations below 300 μg./100 ml. showed a definite poisoning. When the serum iron concentrations exceeded 500 μg./100 ml. a leukocytosis of more than 15,000 cells/ml. was found in 11 of 16 instances. Blood glucose concentrations were usually high. In a scout film of the abdomen radiopaque foreign material in tablet or granular form was visualized in 16 (29%) of 56 patients. Although pre- and post-gastric lavage films were not obtained, the impression was that lavage often fails to remove particulate material completely from the stomach. There were no deaths in this series. Thirty-eight children were treated with the intramuscular or intravenous administration of deferoxamine, 2 critically ill children received the drug by nasogastric tube and intravenously. No toxic effects of deferoxamine were noted.

141. **Infantile renal tubular acidosis due to mercury poisoning**—Husband P. and McKellar W.J.D., Dept of Paed., Charing Cross Group of Hosps, London—ARCH. DIS. CHILDH. 1970, 45 (264-268)

A 9-month-old infant with renal tubular acidosis is reported. This illness followed the use of ammoniated mercury ointment for a diaper rash. Raised levels of inorganic mercury were found in the urine. The patient was treated with alkalis, dimercaprol, and penicillamine. After 5 months, all therapy was discontinued and she has remained well.

142. **Electroencephalographic studies of Minamata disease in children**—Harada Y., Miyamoto Y., Nonaka I., Ohta S. and Ninomiya T.—DEVELOP. MED. CHILD NEUROL. 1968, 10 (257-256)

The EEGs of 32 patients with Minamata disease, a neurological disorder due to poisoning with organic mercury compounds, were examined in 1965 and 1966. Of the 19 congenital cases, 7 showed normal EEGs, 2 were borderline and 10 were abnormal (6 with epileptic discharges); of the 13 acquired cases, in 4 the EEGs were normal, one was borderline and 8 were abnormal (one with epileptic discharges). Specific abnormal patterns in the background activity, with diffuse and slow wave dysrhythmia, appeared in 18 of the 32 cases (56%). No focal abnormalities were seen. The findings suggested that diffuse brain damage is present in Minamata disease.

143. **Acute iron intoxication. A case treated by chelation**—Whelan G., Fazic V. and Biggs J.C., Dept. of Med., St. Vincent's Hosp., Sidney—AMER. J. MED. 1966, 41 (626-628)

A description is given of a 2 year old child who ingested an ordinarily fatal dose of ferrous sulfate (20 g.). The early oral and parenteral administration of deferoxamine undoubtedly had a favorable influence on the ultimate outcome, which was early and complete recovery.

144. **Ferrous sulphate poisoning (Russian)**—Kleut, Jelić R., Sovljanski M., Sovljanski R. and Obradović D., Inst. for Mother and Child Hlth Care, Novi Sad—MED. PREGL. 1971, 24 (383-386)

Two cases of ferrous sulphate poisoning are described: the one, a child of 21 months, ended fatally; the other, a child of 20 months with pronounced indications of poisoning, recovered successfully. in the first case the lethal dose was 466 mg./kg. bodyweight while in the second case the toxic effect was manifested even with only 66 mg./kg. bodyweight. The clinical, pathoanatomical, histological, chemical-toxicological and laboratory findings show that ferrous sulphate poisoning involves a local reaction on the mucous membrane of the stomach and the upper part of the small intestine as well as toxic damage to the liver, the spleen, the brain and other parenchymatous organs during the reabsorption and compounding of iron. Judging from the circumstances under which this poisoning occurred it is worth pointing both to the large and more than lethal dose of poison in individual packets of ferrous sulphate intended for use by adults, and also to the fact that parents are ill-informed concerning its toxic effects.

145. Accidental ferrous sulfate poisoning in a 3-year-old child/ Über eine akzidentelle Eisensulfat-Vergiftung bei einem 3 Jahre alten Kind—Keller P. and Schneider V., Christophorus-Kinderkrankenh., Berlin-Lichtenrade—MSCHR. KINDERHEILK. 1968, 116/8 (476-478)

A 3-year-old child was admitted to hospital because of acute abdominal manifestations, dyspnea and marked abdominal distension. A plain radiogram revealed the signs of massive pneumoperitoneum with marked elevation of the diaphragm. A tentative diagnosis of gastric perforation was made. The child died before an emergency operation could be performed. Autopsy revealed a coin-sized perforation of the posterior gastric wall. The perforation was surrounded by grayish-brown exudate. Hemorrhagic inflammation was present in the area of the perforation. The abdominal cavity contained 100 ml. of a grayish-brown liquid. Histologic study of the liver showed punched-out nuclei in the liver cells such as have been reported in several morbid conditions. The findings suggested the local effect of a corrosive substance. Questioning of the parents revealed a possibility that the child had swallowed a whitish substance present on the terminals of an automobile battery. This substance was shown to be anhydrous ferrous sulfate. Chemical study of the contents of stomach and abdominal cavity revealed a quantity of 6.7 mg. ferrous sulfate. This compound is a dangerous corrosive. The lethal dose for children is from 2 to 10 g. Ferrous sulfate produces severe corrosive injury of the gastrointestinal tract and lesions of the nervous system and liver.

146. Acute iron intoxication. Case report - treatment—Katzman E.C. and Burke W.A.—DELAWARE MED. J. 1967, 39 (317-320, 324)

A 19-month-old boy was admitted to hospital about 1½-2 hours after ingesting an estimated 45-50 ferrous sulphate tablets. He had vomited and had become lethargic and tachypneic, with diarrhea. On arrival at the hospital he was in a state of stupor. He was given intravenous fluids and 5 g. of deferoxamine were placed in the stomach via nasogastric tube following gastric lavage. Additional deferoxamine was given an hour later and 2 hours afterwards. The urine was then deep red. By the following morning the child was more responsive but his respiratory rate increased, with costal retractions and coarse rales becoming audible. Ampicillin therapy was started and further deferoxamine was given, but deterioration continued and grand mal seizures occurred. An exchange blood transfusion was given which was followed by remarkable clinical improvement with cessation of the convulsions. The patient made a gradual uneventful recovery. After 8 weeks there had been no vomiting or other signs of gastrointestinal obstruction and the hemoglobin had remained stable. There was no evidence of pyloric stenosis or scarring elsewhere in the intestinal tract. The authors make recommendations for the treatment of children with acute iron intoxication. As no definite criteria have been established for determining before treatment whether circulatory collapse or CNS depression will occur, they recommend that specific and supportive treatment should be instituted without awaiting the results of serum iron level testing. Deferoxamine has been found to be well tolerated and delay may be costly in terms of increased iron absorption. After the induction of vomiting and the performance of gastric lavage, 4000-8000 mg. of deferoxamine should be instilled into the stomach and 2 g. of deferoxamine in 500 ml. dextrose solution given intravenously over 6 hours. If the urine turns reddish a second course should be given using 1 g. in 250 ml. over 2-3 hours or ½ to 1 g. intramuscularly. Acidosis and dehydration should be corrected and treatment given for shock. If renal function is inadequate, exchange transfusion should be carried out. Serum iron level should be determined before treatment and every 6 hours until it is below 200 mg. An upper gastrointestinal series should be carried out in 3 to 6 weeks (for pyloric stenosis).

147. Lead poisoning in a family of 18 members in Vellore Town—Joshua G.E., Ratnaike N. and Benjamin V., Dept. of Child Hlth, Christian Med. Coll., Vellore—INDIAN J. MED. RES. 1971, 59/9 (1496-1507)

This paper reports chronic lead poisoning in all members of a family consisting of 9 adults and 9 children. The source of poisoning was traced to lead fumes and lead oxide dust emanating during the process of extraction of goid and silver from jewellers' waste. In this study the younger children, aged 3 years and less, were more severely affected than the older members of the family. Children suffered from gastrointestinal disturbances, recurrent respiratory infections and with encephalopathy in the advanced cases. Fatality was confined to the younger age group. On the other hand, adults suffered chiefly from a general intoxication with weakness, lassitude and asthenia. Gastrointestinal disturbances and neuromuscular symptoms were also prominent features. Urine was positive for coproporphyrin intermittently in all members of the family. Blood lead levels in most members during quiescent periods ranged between 50 and 60 μg./100 ml. All members up to the age of 19 years, showed radiological evidence of lead deposit in the bone. Interesting features in these were generalized sclerosis of bone of varying density in the younger members of the family and transient appearance of dense miliary shadows in the lungs of 2 children under 3 years of age.

148. Chronic lead poisoning: recurrent encephalopathy in a child—Joshua G.E., Dept. of Paed., Christian Med. Coll., Vellore—INDIAN PEDIAT. 1969, 6/5 (329-337)

A case of chronic lead toxicity, resulting in recurrent encephalopathy in a child aged 14 months is reported from the town of Vellore in Madras State, South India. This is believed to be the first report in Indian medical literature on lead encephalopathy in children. The parents of this child are engaged in gold and silver recovery process from jeweller's wastes. Inhalation of lead containing fumes and lead oxide laden dust was the main mode of intoxication. Diagnosis was based on the evidence available in the patient's history, family history, father's occupation, clinical signs, laboratory evidence of anemia, increased reticulocyte count, basophilic stippling, elevated urinary coproporphyrin and X-ray evidence consistent with lead deposits in the bones. The findings of lead lines in the gums of parent and elder sibling was further collaborative evidence. The diagnosis was confirmed by identifying the source of lead. Generalized sclerosis of all the bones and the transient appearance of dense miliary shadows in lung were the 2 interesting, unusual features of the case. It is important to bear in mind that undetected lead toxicity may be an etiological factor in some cases of mental deficiency in Indian children.

149. Acrodynia treated with d-penicillamine—Javett S.N. and Kaplan B., Transvaal Mem. Hosp. for Children, Johannesburg—AMER. J. DIS. CHILD. 1968, 115/1 (71-73)

A case of acrodynia in an 8 month old girl treated with d-penicillamine is described. The dosage was 150 mg. 3 times daily for 2 weeks. Clinical improvement was prompt and marked. Over a 3 week period, the patient's urinary excretion of mercury decreased from 1100 μg./l. to nil.

150. Selective pica and lead poisoning in a severely subnormal child—Bicknell J., Queen Mary's Hosp. for Children, Carshalton—J. MENT. DEFIC. RES. 1967, 11/4 (278-281)

A mentally subnormal child with a behavior disturbance who developed pica for wood is described. He showed persistently raised blood lead levels which failed to respond to repeated courses of penicillamine. During this period, no signs of mental deterioration or neurological abnormalities were found.

151. Hyperprolinuria and lead intoxication—Kushnick T., Bilenker R.M. and Sadaty M., Dept. of Ped., New Jersey Coll. of Med. and Dent., Jersey City, N.J.—J. MED. SOC. NEW JERSEY 1967, 64 (262-263)

A study was carried out to determine if there is any relationship between the findings of hyperprolinuria and lead lines in the bones in patients with lead intoxication. Of 16 patients with diagnosed lead poisoning, 9 were found to have hyperaminoaciduria and hyperprolinuria. Five of these had definite lead-lines and 2 had questionable lead lines; 2 had no X-ray findings of lead intoxication. Five additional patients had lead lines but 4 of these had no hyperaminoaciduria or hyperprolinuria. One patient had only hyperaminoaciduria. Two other patients with lead intoxication had no lead lines and only one had increased urinary amino acids without hyperprolinuria. In lead poisoning the lead lines are considered to represent growth retardation due to various factors including inhibition of osteoblastic building activity, inhibition of osteoclasts, and phosphate diuresis due to renal tubular disease. It therefore seemed possible that one mechanism whereby proline might appear in the urine would be its reduced utilization for the formation of hydroxyproline which could then be used for collagen formation. Renal tubular poisoning by lead could also contribute to proline excretion in the urine. The data obtained in this study indicated no relationship between the presence of lead lines in the bones of patients with lead intoxication and their excretion of proline and other amino acids in the urine. Not all patients with lead poisoning and hyperaminoaciduria excrete proline and this variance remains unexplained.

152. Chronic lead poisoning in children: a case report and review of the literature—Cohen B.L., Harper D.L. and Neal W., Div. of Ped., Doctors Hosp., Columbus, O.—J. AMER. OSTEOPATH. ASS. 1968, 67/10 (72-73, 82-84)

The rise in the number of cases of lead poisoning is a source of growing alarm in many major metropolitan centers. However, plumbism is still a rarity in many large communities and poses diagnostic problems. A case in a 19-month-old child is reported in which the diagnosis was obscured by overlying physical findings. It appeared to be a routine case of febrile seizures in overt bronchopneumonia with anemia due to iron deficiency. Only when basophilic stippling appeared was the diagnosis of lead poisoning considered. This case shows that when anemia is present, the history of pica should be sought. When this history is positive, additional studies as outlined herein, should be performed.

Diagnosis and screening

153. Diagnosis of inorganic lead poisoning: a statement—BRIT. MED. J. 1968, 4/5629 (501)

The diagnosis of lead poisoning should be based on clinical findings, biochemical evidence of excessive lead absorption and if possible should be supported by evidence of unusual exposure. Lead absorption can be divided into 4 arbitrary categories which are: (1) Absorption found in the normal population without occupational or abnormal exposure. (2) Increased absorption resulting from occupational exposure which is occupationally acceptable and with no symptoms attributable to it. (3) Increased absorption from excessive occupational or other exposure with mild or severe symptoms or signs, which is unacceptable. (4) Dangerous absorption in which symptoms and long-term sequelae are increasingly probable. Mild symptoms and signs of lead poisoning are non-specific with the exception of a blue lead line in the gums and a metallic taste. Severe symptoms and signs include severe colic, neuropathy and encephalopathy. The incidence of sequelae increases not only with increased absorption but with the length of time that excessive absorption continues.

154. Plumbism—Dept. of Radiol., Maine Med. Cent., Portland, Me.—J. MAINE MED. ASS. 1970, 61 (18)

Although the incidence of lead poisoning has greatly decreased in recent years, the clinician is still faced on occasion with a chronically ill child presenting with a history and symptomatology highly suspicious of lead toxication. The case is described of a 17-month-old girl, admitted to hospital because of persistent vomiting of one week's duration. Of considerable importance in this child's history was his fondness for the paint on the windowsills. The importance of a roentgenographic evaluation is stressed in the diagnosis of lead intoxication. A routine radiologic work-up of such a patient should include single projections of the abdomen and extremities. The plain film of the abdomen will often demonstrate the opaque lead particles within the gastrointestinal tract. However, the most valuable information is often obtained from radiographs of the extremities and pelvis where dense transverse metaphyseal bands are seen just under the epiphyseal plates. The width of the 'lead lines' varies and depends upon the amount of lead ingested and the length of time it has been taken. In the case presented, the lead particles were clearly visualized within the abdomen. The lead lines of the metaphyses are also well seen.

155. Use of the values of ALA dehydratases and coproporphyrinuria in screening for lead poisoning / Utilizzazione dei valori di ALA-deidratasi e coproporfirinuria per la selezione dei soggetti saturnini—Agnese G. and Bonsignore D., Catt. di Statist. Med. e Biomet., Univ. di Genova—FOLIA MED. (NAPOLI) 1968, 51/8 (580-587)

A study was carried out on the usefulness of contemporary determination of values of erythrocytic ALA dehydratases and coproporphyrin urine levels for the purpose of a more efficient differentiation between healthy and saturnine patients. The method of multivaried test is used. By the contemporary determination of the above mentioned values it will be possible to obtain a particularly reliable differentiation.

156. Comparison of delta-aminolevulinic acid levels in urine and blood lead levels for screening children for lead poisoning—Murphy T. and Lepow M.L., Univ. of Connecticut Sch. of Med., Storrs, Conn.—CONN. MED. 1971, 35 (488-492)

As part of a screening program urinary δ-aminolevulinic (ALA) levels and blood lead levels were measured in 76 children from 'high risk' areas. Forty-eight children had normal blood lead and urinary ALA levels, 18 had elevated ALA levels with normal blood lead levels, 5 had elevated blood lead levels with normal urinary ALA and 5 had elevated levels of both blood lead and urinary ALA. Of the 5 children with elevated blood lead levels and normal urinary ALA, 3 had had an elevated ALA test 1-4 months previously. False negative ALA levels may reflect variable urinary ALA output or destruction of the ALA present in the urine when passed before testing. It is suggested that abnormal ALA excretion with normal blood lead levels may be due to sequestration of the lead in body tissues. The measurement of urinary ALA levels in random urine samples alone will fail to identify a significant number of children with elevated blood lead levels who may require treatment. It is also suggested that both tests should be used together.

157. Screening for lead poisoning—Lin-Fu J.S., Matern. and Child Hlth Serv., US Dept. of Hlth, Educ. and Welf., Washington, D.C.—PEDIATRICS 1970, 45 (720-722)

Screening for lead poisoning has 2 aspects, firstly for evidence of increased lead absorption and secondly for evidence of lead toxicity. A mass screening program should be designed to detect the child with asymptomatic increased lead absorption prior to the appearance of actual lead poisoning. Lead in the hair appears to be related to increased exposure and absorption. The lead level in capillary blood obtained by a finger prick may be practical approach but there are problems in the present methods of blood lead determinations. Increased aminolevulinic acid (ALA) in blood or urine is a biochemical manifestation of lead poisoning at the metabolic level. Recent investigations indicate that urine ALA determinations have their limitations. The sensitivity of the test as an early indicator of increased exposure to lead has been questioned. The validity of random samples of urine for ALA determinations is also in doubt.

158. Lead poisoning - children at risk—NATURE 1970, 228 (1253)

The New York City Bureau of Lead Poisoning Control has been conducting a screening program for children and endeavoring to provide preventive care. It is estimated that between 6000 and 8000 children in the city have pathologically significant blood lead levels. The number of deaths has dropped sharply because of improved testing but for the same reason the number of known non-fatal cases has risen from 151 in 1959 to nearly 2500 in 1970. The main source of poisoning is the ingestion by children of chipping paint in old apartments. The Bureau screened more than 79,000 children in 1970 and found that 2500 had a blood lead level of at least 60 µg./100 ml. - the accepted definition of a positive case. The apartments where these 2500 children lived were inspected by the Bureau. If any painted wall was found to have more than 1% of lead the area was required to be repaired and painted, either by the landlord or by the Bureau at his expense. Because of limited staff and budget it was not possible to test the homes of 31,000 children who had lesser amounts of lead in their blood nor to investigate the other 400,000 odd apartments that are probably also contaminated.

159. The excretion of delta-aminolaevulinic acid by children—Barltrop D., Paed. Unit, St Mary's Hosp. Med. Sch., London—ACTA PAEDIAT. SCAND. 1967, 56 (265-268)

Twenty-four-hour urine specimens were collected from 339 children aged 0-12 years admitted to hospital over an 11-month period. The mean excretion of δ-aminolevulinic acid (ALA) per 24 hours was 1.61 mg. with a range of 0.0-6.5 mg. Ninety-five percent of the values were in the range 0.08-4.39 mg./24 hours. The mean excretion of ALA per unit bodyweight was 0.08 mg./kg. bodyweight/24 hours and this value did not vary with age. A seasonal variation in the mean excretion of ALA per unit bodyweight was found with maximum values in the winter months and minimum values in the summer.

160. Faecal excretion of lead by children—Barltrop D. and Killala N.J.P., Paed. Unit, St Mary's Hosp. Med. Sch., London—LANCET 1967, 2 (1017-1019)

Fecal lead is a sensitive index of ingested lead. Normal values for children aged 2 years have been determined and contrasted with the findings in 3 cases of lead poisoning. Fecal lead determinations have a place in population screening programs and in the interpretation of blood-lead values in children.

161. Lead intoxication in children. Diagnosis and treatment—Graef J.W., Kopito L. and Schwachman H., Child. Hosp. Med. Cent., Boston, Mass.—POSTGRAD. MED. 1971, 50 (133-138)

In the diagnosis of lead overload the most important and practical evidence is provided by a lead mobilization test. Urinary lead excretion in the 24 hours after the administration of a single dose of a chelating agent EDTA (50 mg./kg. bodyweight) of over 500 μg. indicates excessive lead burden. In a series of 184 children with lead intoxication, over a third had blood lead levels below 50 μg./100 g., but more than half of these had a positive lead mobilization test.

162. Blood lead levels in normal and mentally deficient children—Gibson S.L.M., Lam C.N., McCrae W.M. and Goldberg A., Dept. of Med., Univ. of Glasgow—ARCH. DIS. CHILDH. 1967, 42/226 (573-578)

A series of prepubertal children were investigated for evidence of exposure to lead. The series comprised 20 children of normal intelligence (group A), 20 with mental deficiency of known etiology (group B), and 20 who were mentally deficient from unknown etiology (group C). Three children in group A and 6 in group C were found to have blood lead levels greater than 40 μg. 100 g. blood. In these the urinary lead excretion was normal but was increased significantly after an oral dose of 300 mg. penicillamine. This test (the penicillamine-lead excretion test) and the blood lead levels are shown to be the most helpful procedures in the diagnosis of lead exposure in childhood. The presence of a raised erythrocyte protoporphyrin level is suggestive of lead exposure, but in contrast to adult lead poisoning urinary coproporphyrin and δ-aminolevulinic acid estimations are of no value in the detection of this state. All of the 9 children with raised blood lead levels had a history of pica and with one exception lived in old houses. Furthermore, there were no children with raised blood lead levels in group B which contained children with organic brain damage some of whom were severely immobilized and consequently were more closely supervised than those in the other 2 groups. This emphasizes the importance of pica and of access to environmental lead in the development of lead intoxication. There is evidence that lead inhibits an important heme enzyme in the brain (ALA dehydrase) and that acute lead intoxication leads in some cases to mental deficiency or aggravates a pre-existent mentally deficient state. The growing brain of young animals is more susceptible to damage by lead than that of adult animals. These considerations acid weight to the suggestion that previously undetected lead poisoning may be a factor in the development of some cases of mental deficiency, but the problem requires further investigation.

163. **The resolution on childhood lead poisoning**—Blanksma L.A., 2951 King Drive, Chicago, Ill.—AMER. J. PUBL. HLTH 1970, 60/7 (1191-1193)

The resolution on childhood lead poisoning reported in the American Journal of Public Health in 1970 is criticized in this article. The present author agrees with the call for prompt treatment and comprehensive follow-up of all detected cases, and feels this to be the most important part of the resolution. He disagrees with the resolution on the question of mass urine testing for excessive lead content, which it advocates. Urine lead analysis has no diagnostic screening value, urinary concentrations not always being high when blood lead is high, excretion of lead in urine being variable, and specimens being difficult to obtain. Blood lead analysis is the only sage method for screening children. Testing and treatment of ghetto housing is also recommended in the resolution. The present author feels however that so many of these houses are at fault that identification is hardly necessary and anyway could follow testing of children, and that even if all paint in these buildings were rendered inaccessible the effect which would result on the incidence of childhood poisoning is unknown, the buildings containing numerous other hazards.

164. **Serum δ-aminolevulinic acid in plumbism**—Feldman F., Lichtman H.C., Oransky S., Sta Ana E. and Reiser L., Dept. of Ped., Coney Island Hosp., Brooklyn, N.Y.—J. PEDIAT. 1969, 74/6 (917-923)

Blood lead and serum δ-aminolevulinic acid (ALA) levels were determined in groups of children with increased lead absorption, lead intoxication, and lead encephalopathy. Although blood lead values tended to be higher in children with intoxication, they tended to overlap those of patients with increased absorption but without intoxication. Serum ALA was consistently higher in patients with overt toxicity, with almost no overlapping of values. Blood lead and serum ALA levels were both markedly elevated in patients with encephalopathy. Lead and ALA values failed to correlate well. Cerebrospinal fluid ALA values were consistently lower than serum values. It is concluded that serum ALA determinations are valuable in selecting infants who are intoxicated from those exposed to increased amounts of lead.

165. **Use of urinary ALA levels as a large-scale screening technique for the detection of early lead exposure in children**—Davis J.R., Abrahams R.H., Andelman S.L. and Fabrega E.A., Loyola Univ. Stritch Sch. of Med., Hines, Ill.—FED. PROC. 1968, 27 (466)

The use of disposable ion-exchange chromatography columns prefilled with resin has markedly simplified the analysis of urinary δ-aminolevulinic acid (ALA). Urinary ALA-levels were determined in 3510 children residing in high-incidence areas of lead poisoning in Chicago, employing 0.5 ml. of a random urine sample. A total of 216 children (6.1%) were found to have elevated urinary ALA values greater than 1.00 mg.%, with 188 values between 1.00-1.49 mg.%, 15 values between 1.50-1.99 mg.%, 11 values between 2.00-2.99 mg.% and 2 values between 3.00-5.99 mg.%. The correlation of urinary ALA values with the clinical diagnosis of lead exposure was investigated in an additional series of 250 children suspected of lead ingestion because of an initially elevated blood level value. Following clinical examination, the incidence of a correct correlation between urinary ALA and the diagnosis of lead exposure was 91%. These data indicate that urinary ALA testing employing easily obtainable random urine samples constitutes a practical and accurate large-scale screening technique for the detection of early lead exposure in asymptomatic children.

166. Reliability of urinary delta-aminolevulinic acid as a mass screening technic for childhood exposure to lead—Davis J.R., Loyola Univ. Stritch Sch. of Med., Maywood, Ill.—AMER. J. CLIN. PATHOL. 1970, 53 (967-969)

The author reports laboratory experience in using urinary δ-aminolevulinic acid (ALA) levels to detect exposure to lead in children. The laboratory modified the determination of urinary ALA by introducing dual disposable chromatographic column units prefilled with resin that could be conveniently held in a support rack over a drain tray, and a kit is now available commercially. A table is given showing statistical comparison of urinary ALA and blood lead values and a comparison of urinary ALA levels with chelation therapy in 233 children with elevated ALA (over 1.00 mg./100 ml.). The data indicate a positive correlation between elevated urinary ALA levels and increased exposure to lead in children. A second study to find the incidence of possible false-negative values of urinary ALA was made of 3068 children with normal levels of urinary ALA below 1.00 mg./100 ml., basing the incidence of false-negatives on a determination of blood lead by atomic absorption spectrometry. Only 1.1% of these children had possible false-negative urinary ALA values in terms of blood lead levels greater than 60 μg./100 ml. and only 0.14% had possible false-negative urinary ALA values in terms of blood lead levels greater than 80 μg./100 ml. The proper preservation and storage of the urine sample is important. In view of the possibility of evaporation of the small quantity of acetic acid used, it is recommended that tartaric acid-coated vials should be used or citric acid dried in the vials. The use of urinary ALA was never intended to replace the determination of blood lead levels but it remains the only practical large-scale screening technique for the detection of increased exposure to lead in small children which is available at present.

167. Lead poisoning in children: detection by ion-selective electrode—Rechnitz G. A., Dept. of Chem., State Univ. of New York, Buffalo, N.Y.—SCIENCE 1969, 166 (532)

Attention has been drawn to the need for more rapid and sensitive detection methods of lead poisoning in children caused by the ingestion of lead-based paints, which can be used for the diagnostic screening of large numbers of children. An analytical device is a solid-state ion-selective membrane electrode selective for lead ions in solution. This electrode seems to have the appropriate characteristics of sensitivity (to as low as 10^{-7}M Pb^{2+}) and selectivity (normal ionic constituents of body fluids should not interfere) to warrant further exploration of its use as a diagnostic tool. Similar electrodes, selective for Cl^-, are being used for the detection of cystic fibrosis in children.

168. Bismuth ingestion simulating acute plumbism on abdominal roentgenogram—Heller R.H. and Waitsman E.S.—J. PEDIAT. 1970, 70/4 (637-638)

A case report is presented of a 3 year old child seen for evaluation of pyrexia of 3 weeks' duration without other symptoms except occasional mild diarrhea. He was known to ingest dirt. Besides pyrexia the only other abnormal finding on examination was equivocal left lower quadrant tenderness. Blood count, electrolytes, urine, marrow and chest X-ray were normal. Abdominal film showed numerous scattered radiopaque flecks suggestive of paint-chip ingestion. Urinary test for coproporphyrin was negative; blood lead was 0.013 mg./100 ml. Stool inspection revealed chunks of material shown chemically to contain large amounts of bismuth which might have come from a proprietary bismuth mixture kept in the home. Stool culture was positive for *Salmonella typhimurium;* blood titer for this organism was 1 : 128. Ampicillin was given orally for 14 days; the child rapidly became afebrile.

169. Enzyme inhibition by lead under normal urban conditions—Hernberg S. and Nikkanen J., Inst. of Occupational Hlth, Helsinki—LANCET 1970, 1 (63-64)

A close negative correlation was found between the concentration of lead in blood and the activity of erythrocyte δ-aminolevulinic acid dehydrogenase in 26 healthy individuals, never exposed occupationally to lead. The results indicate that present levels of environmental contamination with lead can produce a measurable biochemical alteration in man.

170. Effects of abnormal lead content of water supplies on maternity patients. The use of a simple industrial screening test in ante-natal care in general practice—Wilson A.T.—SCOT. MED. J. 1966, 11/3 (73-82)

In a small town and rural practice it was found that the water supplies intermittently exceeded the present WHO standard limit for lead content of 0.05 mg./l. owing to their aggressive action on lead pipes. All the routine urine samples of all the maternity patients were used for a study over a 2-year period. A simple industrial screening test for increased urine coproporphyrin showed differences, of statistical significance, in results before and after restriction of intake of water. There were also differences on less detailed comparison of groups of patients in other practices on hard and soft water supplies. Only 2% of 404 hospital antenatal patients showed urine coproporphyrin results in the range 100 to 200 μg./l. or higher. Eleven of 35 patients in the practice (31%) subject to no water restriction reached this level at some stage during their antenatal supervision. One stillbirth from a series of 75 pregnancies studied gave evidence of abnormal exposure to lead, having increased fetal kidney and maternal blood lead levels. On one very unsatisfactory water supply a patient had a history of miscarriage or antepartum hemorrhage in 7 of 8 pregnancies. A patient with a raised antenatal urine coproporphyrin output had a baby with congenital nystagmus and partial albinism. In some instances blood lead estimations were extraordinarily low. Difficulties in the interpretation of blood lead levels have been related to certain alterations in the blood chemistry in pregnancy.

171. Chronic plumbism in children. Diagnosis by hair analysis—Kopito L., Briley A.M. and Shwachman H., Div. of Clin. Labs, Dept. of Med., Child's Hosp. Med. Cent., Boston, Mass. —J. AMER. MED. ASS. 1969, 209/2 (243-248)

The determination of lead in scalp hair is a valuable diagnostic aid in chronic of mild lead intoxication particularly when the other clinical or laboratory evidence is of questionable diagnostic quality. This continuously growing tissue accumulates and stores lead for long periods and may be used for estimating the time and duration of the exposure. Hair is easy to obtain, store, transport, and analyze and may provide a practical means for finding little children who may have been exposed to lead.

172. Lead ingestion in New Orleans children—Blumenthal D., Dept. of Ped., Tulane Med. Sch., Charity Hosp., New Orleans, La.—STH. MED. J. (BGHAM, ALA.) 1971, 64/3 (364-365)

The use of a simple screening procedure is described to detect increased body burdens of lead in asymptomatic children. One hundred children, aged 1-5, from low income families were selected at random. Urine samples were collected and qualitative coproporphyrin tests were performed using the de Langen and ten Berg method as modified by McCord.

Asymptomatic children with positive urine coproporphyrin were studied further by means of blood lead determinations, radiographs of the abdomen and long bones, hemoglobin determinations, and inquiries as to possible sources of lead. Four children were found to have coproporphyrin in the urine. Of these, one child had a normal blood lead level and no other evidence of lead poisoning. The other 3 exhibited evidence of increased lead exposure. Two of the children had been observed to ingest paint and plaster fragments. Neither had significant anemia nor radiologic evidence of lead poisoning. Both children were clinically asymptomatic. The housing conditions of the children were not investigated. A sample limited to children living in deteriorating houses may yield a higher percentage of subclinical lead poisoning. Comparison of the present report with other studies of increased body burden of lead in asymptomatic children indicates that in susceptible population groups 3-8% of preschool children show elevated body burdens of lead. The use of a simple screening test may prove to be useful in the control of lead poisoning.

173. Incidence of high blood lead levels in Chicago children—Blanksma L.A., Sachs H.K., Murray E.F. and O'Connell M.J., Chicago Board of Hlth, Chicago, Ill.—PEDIATRICS 1969, 44/5 (I) (661-667)

The Chicago Board of Health in October 1966 began a mass-screening program using a blood lead test to detect lead poisoning in children. Atomic absorption spectroscopy made it possible to screen 5000 specimens in 1 month and to test a total of 68,744 children in 2 years. The incidence of high blood lead values was variable and seasonal; it was lowest in November through January and highest in June. Control children exhibited the same seasonal variation in lead levels as did the children at-risk for lead poisoning. As a result of this program, 1154 children were treated with chelates for lead poisoning in 1967 and 1968 at the Lead Poisoning Clinic, and the incidence of high blood lead levels among children living in the same areas declined from 8.5% in 1967 to 3.8% in 1968.

174. D.C. mounts unfunded program of screening for lead poisoning—Conn R.H. and Anderson D., D.C. Dept. of Hum. Resources, Commun. Hlth Serv. Administ., Washington, D.C.—HSMA REP. 1971, 86/5 (409-413)

A nonfunded screening program for lead poisoning was launched in 1970 by the Health Services Administration of the District of Columbia's Department of Human Resources. The organization and the results of the screening program are summarized. Blood samples were taken from 808 children ranging in age from 1-8 and over. 165 children (20.4%) had pica. Of this group, 47 children (5.8%) had elevated blood-lead levels of at least 40 μg./100 ml. In these children pica was reported in 44.7%. For the 476 children under age 5 (58.9% of the total who were tested), the mean blood-lead level was 26.4 μg. as compared with a mean blood lead level of 25.0 for all children tested. It is well known that children in this age group are more likely to have a higher level because of the tendency to pica. No child living in more recently built projects had a blood lead level above 39.9 μg. In fact, all but 1 of these children had levels below 34.9 μg. In the areas of deteriorating houses in the District of Columbia, 11.2% of the children under 5 years had elevated blood-lead levels. Referrals to Children's Hospital for additional diagnosis and treatment were made for 47 children with levels of 40 μg. or higher. Of these,5 children (10.6%) were admitted to the hospital for treatment.

Laboratory methods

175. The unsuitability of random urinary delta aminolevulinic acid samples as a screening test for lead poisoning—Specter M.J., Guinee V.F. and Davidow B., Cent. for Dis. Control, US Dept. of Hlth, Educ. and Welf., New York, N.Y.—J. PEDIAT. 1971, 79/5 (799-804)

Lead poisoning in childhood is a significant health problem which has prompted the initiation of mass screening programs to detect children in danger of developing this disease. In this study, multiple urine specimens were collected on consecutive days and tested for the presence of δ-aminolevulinic acid (ALA) in a group of children who were living in a 'lead-free' environment and in another group with evidence of significant lead ingestion. No single value for ALA was found which separates the normal children from those with an increased body burden of lead. In random, untimed samples of urine the presence of 'abnormal' ALA values in normal children and 'normal' values in children with lead poisoning makes such testing unsuitable for screening purposes.

176. Determination of lead in blood by atomic absorption spectrophotometry—Selander S. and Cramér K., Med. Serv. I, Dept. of Hyg., Univ. of Göteborg—BRIT. J. INDUSTR. MED. 1968, 25 (209-213)

Lead in blood was determined by atomic absorption spectrophotometry, using a wet ashing procedure and a procedure in which the proteins were precipitated with trichloroacetic acid. In both methods the lead was extracted into *iso*butylmethylketone before measurement, using ammonium pyrrolidine dithiocarbamate as chelator. The simpler precipitation procedure was shown to give results identical with those obtained with the ashing technique. In addition, blood specimens were examined by the precipitation method and by spectral analysis, which method includes wet ashing of the samples, with good agreement. All analyses were done on blood samples from 'normal' persons or from lead-exposed workers, and no additions of inorganic lead were made. The relatively simple protein precipitation technique gave accurate results and is suitable for the large-scale control of lead-exposed workers.

177. The level of lead in the blood and the excretion of 5-aminolevulinic acid / Bleigehalt im Blut and 5-Aminolävulinsäure-Ausscheidung—Bäumler J., Gerichtl.-med. Inst., Univ. Basel—Z. PRÄV. MED. 1966, 11/3 (265-275)

The micro-determination of lead in blood is mentioned and the excretion of 5-aminolevulinic acid in urine is discussed. For the clarification of the influence of lead on a larger collection it is proposed to determine the amount of 5-aminolevulinic acid in the first sample of urine in the morning. Detailed instruction for this procedure is given. Based on the results of a great number of experiments the level of lead in blood and the excretion of aminolevulinic acid in urine are compared. It is found that concentrations below 600 mg.% 5-aminolevulinic acid in morning urine are normal.

178. Quantitative coproporphyrin determinations / Zur Praxis der quantitativen Koproporphyrinbestimmung im Harn—Kisser W., Inst. für Gerichtl. Med., Univ. Wien—ZBL. ARBEITSMED. 1968, 18/12 (368-371)

Side by side with coproporphyrin, its biogenetic precursor, coproporphyrinogen, is also excreted with the urine in variable quantities. It can be transformed into coproporphyrin by oxidation, preferably by exposure to light of the solution in ether. Since there is no fixed ratio of the coproporphyrin and coproporphyrinogen levels, the quantitative determination of the total porphyrin excretion always requires the transformation of coproporphyrinogen into coproporphyrin. If samples of urine are kept at room temperature for periods of up to 24 hours, a considerable loss of porphyrin occurs, so that the results are no longer suitable for diagnostic purposes. Consequently, if it is not possible to analyze the urine within 4 to 5 hours after micturition, the samples should be kept in the refrigerator (for not longer than 24 hours). If longer storage at room temperature is unavoidable (*e.g.* if the sample is to be dispatched by post), preservation of the urine should be carried out immediately after micturition; the method is described. However, even if this treatment is applied, a significant loss of porphyrin must be taken into account. In any case, the urine should be kept in absolute darkness during storage.

179. The effect of lead and ferrous and ferric iron on δ-aminolaevulic acid synthetase—Morrow J.J., Urata G. and Goldberg A., Univ. Dept. of Med., Western Infirm., Glasgow—CLIN. SCI. 1969, 37 (533-538)

Properties of the enzymes δ-aminolevulic acid synthetase were studied using particles of chicken cell hemolysate as the source of enzyme, glycine and α-ketoglutarate as substrates, and optimal concentrations of pyridoxal phosphate, coenzyme A, EDTA and $MgCl_2$. Ferrous iron in concentrations of 10^{-6}M increased the activity of the enzyme by 12% and at 10^{-3}M depressed activity by 56%. Ferric iron had no stimulating action but depressed activity by 12% at 10^{-3}M. Lead caused progressive depression of activity with increasing concentration.

180. Procedure for the determination of lead-210 and total lead in biological samples—Langford J.C., Batelle Mem. Inst., Pacific Northwest Lab., Richland, Wash.—ANALYT. CHEM. 1969, 41 (1716)

An improved method was described for the preparation of stable lead extracts from biological samples for assay by atomic absorption spectrometry. Samples were ashed at under 500°C, although urine was acidified with nitric acid, dried under a lamp and wet-ashed with nitric acid and perchloric acid. The ash was dissolved in 50 ml. of hot 0.6 M hydrochloric acid, with the addition of 100 μg. of bismuth carrier and a specially prepared ^{212}Pb sample. The cooled solution was extracted twice with 20 ml. of 1% diethylammonium-diethyl-dithiocarbamate in chloroform. The organic phase was evaporated after acidification with nitric acid, and any charred organic matter was destroyed with nitric acid, hydrogen peroxide and perchloric acid. The acidic residue was taken up in water and diluted to 8 ml. A further 2 ml. of 9 M sodium iodide was added, and the mixture was extracted twice with 10 ml. of hexone (isobutyl-methyl-ketone) pre-treated with 1 M hydrochloric acid. Yields were determined by measurements of the ^{212}Pb radioactivity. A 2 ml. aliquot of the hexone phase was used to determine total lead by atomic absorption analysis. The remaining hexone phase was evaporated, treated with nitric acid and stored for 5 days. The ^{212}Bi beta particle emission was then counted in order to determine ^{210}Pb levels. With this procedure, the extraction gave 70.5 ± 11% yields from biological samples, and 5 μg. of lead could be measured with ± 20% accuracy.

181. X-ray fluorescence: detection of lead in wall paint—Laurer G.R., Kneip T.J., Albert R.E. and Kent F.S., Inst. of Environm. Med., New York Univ. Med. Cent., New York, N.Y. —SCIENCE 1971, 172 (466-468)

An instrument has been developed for the *in situ* determination of lead on painted surfaces. It utilizes, as a source of gamma rays, radioactive cadmium-109 and its daughter silver-109 (metastable) to excite the K series X-rays of lead, and a solid-state, lithium-drifted germanium detector. The device, which is capable of detecting 0.26 mg. of lead per square centimeter of paint (approximately 3% (by weight) of lead in a single coat) beneath 10 layers of lead-free paint, has been tested in a preliminary survey of several tenement apartments in New York City.

182. A reliable and rapid method for the determination of lead in small quantities of blood / Eine zuverlässige Schnellmethode zur Bleibestimmung in kleinen Blutmengen—Lehnert G., Schaller K.-H. and Szadkowski D., Inst. für Arbeits- und Sozialmed., Univ. Erlangen-Nürnberg—Z. KLIN. CHEM. KLIN. BIOCHEM. 1969, 7/3 (310)

The conventional techniques for the determination of blood lead levels are not entirely conclusive and require experience on the side of the analyst. In previous publications the authors described a technique using atomic absorption spectrophotometry which has proved its value in 6000 analyses. An improved modification is described: 0.1 ml. of a 50% aqueous solution of crude agal and 1 ml. of a 5% aqueous solution of ammonium-pyrrolidine-dithiocarbamate are added to 2 ml. of whole blood. The mixture is homogenized by centrifugation. Following addition of 1 ml. of methylisobutylketone the mixture is shaken for 2 minutes and the organic portion is removed by centrifugation. This portion is used for determination of lead by atomic absorption spectrophotometry. The method has proved accurate and specific. It can be carried out in less than 10 minutes, it requires a small volume of blood, and the hazards of lead loss or contamination are reduced. This technique is suitable for routine blood checks for lead in the surveillance of lead exposed workers.

183. A simplified screening test for exposure to lead—Morgan J.M., Ren. Res. Lab., V. A. Hosp., Birmingham, Ala.—STH. MED. J. (BGHAM, ALA.) 1967, 60/4 (435-438)

EDTA may be used orally to demonstrate excessive absorption of lead in the past. The test is simple, safe and effective in detecting persons who have been subjected to excessive storage of lead. A very significant proportion of men over 35 years of age in the South, particularly among Negroes, demonstrate excessive storage of lead as a result of previous regular use of illegally produced alcohol. Most of these persons do not have clinically recognized evidence of lead toxicity. Further studies are needed to elucidate the longterm consequences of this excess.

184. Changes of the isoenzymatic fractions of the erythrocytic lactodehydrogenase in saturnine anemia - Modificazioni delle frazioni isoenzimatische della lattato-deidrogenase (LDH) eritrocitaria nell'anemia saturnina—Secchi G.C. and Alessio L., Clin. del Lav. 'L. Devoto', Univ. di Milano—MED. D. LAVORO 1968, 59/12 (784-792)

The changes of the isoenzymatic fractions of the erythrocytic lacticodehydrogenase (LDH) were studied in 11 workers engaged in the production of electric accumulators, who presented clinical hematological and biochemical signs of lead poisoning. The characterization of LDH isoenzymes was obtained by Cellogel electrophoresis; the fractions were demonstrated by a method based on the reduction of tetrazolium salts. In the saturnine subjects a significant increase of the cathodic isoenzymatic fractions (LDH IV and V) was demonstrated. On the basis of the known data of the literature on the localization of LDH V in the nuclear structures, this finding can be attributed to the persistence in the red blood cells of saturnine subjects of enzymatic proteins derived from the nucleus. The high values of the cathodic fractions of LDH in the saturnine anemia might indicate the existence of a red blood cell population with at least partial characters of immaturity.

185. **A spot test for detection of lead in paint**—Sayre J.W. and Wilson D.J., Dept. of Ped., Univ. of Rochester Sch. of Dent., Rochester, N.Y.—PEDIATRICS 1970, 46/5 (783-785)

A method of testing is proposed which is simple, inexpensive, and specific, and can be performed in the patients home. It involves the precipitation of lead as an insoluble black sulfide through the following reaction: $Pb + Na_2S\ PbS$. The specificity and sensitivity of this method are briefly discussed.

186. **Inverse voltammetric determination of lead in small blood samples. I. Determination after dry-ashing / Inversvoltammetrische Bestimmung von Blei in kleinen Blutmengen. I. Bestimmung nach Trackenveraschung**—Roschig M. and Matschiner H., Anorgan. Chem. Inst., Martin-Luther-Univ., Halle Wittenberg—Z. MED. LABORT. 1970, 11/1 (7-16)

A micromethod for the determination of the lead concentration in capillary blood taken from the ear is described. The volume of blood required is 0.2 ml. and the method is able to detect a concentration of 0.1 parts per million. After dry incineration and disintegration of the ash with hydrochloric acid, the lead content of the sample is determined by anodic stripping in the presence of ascorbic acid. The relative standard deviation of the method was found to be 12%. One worker can perform about 20 determinations in one working day.

187. **Toxicology. Technique of emission spectrographic demonstration of heavy metals in biologic material / Toxikologie. Zur Technik des emissionspektrographischen Nachweise von Schwermetallen in biologischem Material**—Geldmacher-v. Mallinckrodt M., Inst. für Gerichtl. Med. und Kriminalist., Univ. Erlangen-Nürnberg—DTSCH. Z. GES. GERICHTL. MED. 1967, 59 (280-286)

For the detection of heavy metals of forensic importance in organs and body fluids it is useful to extract them with diethylammonia-diethyldithiocarbamate in chloroform after mineralization and to analyze the residue of the organic phase after absorption to carbon powder spectrographically. Thus it is possible, for example, to detect even such small amounts as 1 μg. of lead, mercury and thallium and 5 μg. of arsenic in 100 ml. of urine or 10 g. of liver.

188. **Large lymphocytes in the peripheral blood in cases of saturnism / Sui grandi linfociti del sangue dei saturnini**—Ambrosi L., Vimercati F. and Di Nunno C., Ist. di Med. Leg. e delle Assicur., Univ. di Bari—MED. D. LAVORO 1968, 59/2 (125-135)

High percentages of large lymphocytes were found in the peripheral blood of 20 patients with saturnism. These cells, stained by the method of Unna-Pappenheim, showed an intense cytoplasmic basophilia. In the peripheral blood of 20 subjects not exposed to lead, the percentage of large lymphocytes was within normal limits. The results are discussed on the basis of bibliographic data on the significance of the large lymphocytes and of changes of Coombs' test in saturnism. The usefulness of the determination of large lymphocytes in saturnism is stressed.

189. Simple methods for the determination of δ-aminolevulinic acid in the urine / Die einfachen Bestimmungsmethoden der δ-Aminolävulinsäure im Harn—Grabecki J., Haduch T. and Urbanowicz H., Toxikol. Abt., Inst. für Arbeitsmed., Zabrze—INT. ARCH. GEWERBEPATHOL. GEWERBEHYG. 1967, 23 (226-240)

A comparison was made of several simple methods for the determination of δ-aminolevulinic acid (ALA). The best method was found to be that of Mauzerall and Granick but the length of time required for its completion is a drawback in routine work. A modification is described which reduces the time for performance of the analysis to 20 minutes. The principle of the method is the condensation of the ALA in the urine with acetylacetol to a pyrrole which is estimated spectrophotometrically by the formation of a color complex with p-dimethylaminobenzaldehyde in acid solution. The precision and accuracy were found to be satisfactory, and there was good agreement between the results obtained by the modified and unmodified methods. This modification should have wide application in the routine diagnosis of lead poisoning.

190. Application of the polarograph by anodic redissolution in biochemistry. I. Estimation of lead in the urine / Application de la polarographie par redissolution anodique en biochimie. I. Dosage du plomb urinaire—Girard M.-L. Dreux C., Paolaggi F. and Delattre J., Chaire de Biochim. Appl. et CES d'Electrochim. Appl. à l'Analyse, Fac. de Pharm., Paris—ANN. BIOL. CLIN. 1968, 26/3-4 (401-415)

The application of polarography by anodic redissolution while avoiding mineralization of the samples, allows the rapid and accurate estimation of very small quantities of lead in the urine of the order of 0.01 μg./ml even in the presence of a complex agent like EDTA. A certain number of conditions are indispensible to obtain quantitative and reproducible results, either by the electrochemical method (temperature, time of electrolysis, surface of the droplet) or by the nature of the metallic element as well as the complexity of the biological medium. These conditions were determined during a systematic analytical study. The values of lead in the urine obtained by this method in normal subjects were between 0 and 28 μg./l., slightly less than those obtained by classical methods.

191. Dry destruction technique for the identification of trace elements in biological milieu. Application to the urinary excretion of lead / Méthode de destruction par voie sèche pour la recherche des traces d'éléments dans les milieux biologiques. Application à la détermination de la plomburie—Truffert L. and Girard-Wallon C., Inst. d'Hyg. Industr. et de Méd. du Travail, Paris—ARCH. MAL. PROF. 1968, 29/1-2 (23-28)

The technique of dry mineralization allows simultaneous processing of numerous urine specimens without special surveillance. An original apparatus consisting entirely of quartz and Pyrex glass was designed to obtain the mineralization of the specimen. A number of technical details are given. The percentages of recovery for contents of 0.5 mg./l. to 1.0 mg./l. lead varied from 90 to 100. The results of square wave polarography of different elements studied in mineralized human urines are tabulated. It was shown that the lead contents calculated corresponded fairly well to the quantities of this element introduced into the specimens.

192. New screening test for stippled red cells. Confirmation by this test of the identity of the reticulocyte, the stipped red cell and the red cell with diffuse polychromasia / Nouvelle méthode de recherche des hématies ponctuées. Confirmation, grace à elle, de l'identité du réticulocyte avec l'hématie ponctuée et l'hématie à polychromasie diffuse—Van Houte G. and Cocle P., Serv. Méd. des Tréfileries Léon Bekaert, Zwevegem—ARCH. MAL. PROF. 1968, 29/7-8 (403-410)

A number of workers have advanced the theory that stippled red cells, erythrocytes with diffuse polychromasia and reticulocytes are only different forms of a single cell type, the young or immature erythrocyte (proerythrocyte). The blood of 65 individuals exposed to lead but without clinical signs of lead poisoning was studied. The following techniques were employed: (1) An original method of fluorescent microscopy using an orange acridine stain; (2) other types of stains (cresyl blue, Manson-Schwarz, and Wright). The technical details are presented. The comparative results are tabulated. It was shown by painstaking enumeration that stippled red cells, polychromatophil erythrocytes and reticulocytes indeed are only different types of the young erythrocyte. Their different morphology is the result of varying laboratory manipulations. In another small series comprising normal individuals or patients with diseases other than lead poisoning the numbers of reticulocytes and stippled red cells were also comparable. The somewhat particular appearance of basophilic stippling in the red cells of individuals exposed to lead is considered to be due to the inhibitory effect of lead on the enzymatic processes of cell catabolism. Specialists in industrial medicine are advised to enumerate all proerythrocytes by the conventional cresyl blue technique or preferably by fluorescent microscopy of specimens stained with orange acridine instead of the Manson-Schwarz count of stippled red cells.

193. The measurement of urinary delta-aminolevulinic acid in detection of childhood lead poisoning—Vincent W.F., Ullmann W.W. and Weidner G.L., Connecticut State Dept. of Hlth, Hartfold, Conn.—AMER. J. CLIN. PATHOL. 1970, 53 (963-966)

Different opinions of the test for increased urinary δ-aminolevulinic acid (ALA) as an indication of early asymptomatic lead poisoning in children are presented. One series shows that there is a complete lack of correlation between urinary ALA levels and blood lead in several thousand children. Up to 75% false negative ALA tests were obtained in another series of 250 children, though the incidence of false negatives falls to 31% when blood lead increases to the range 60-200 μg./100 ml. whole blood. Other authors, however, report positive correlations between ALA and blood levels in more than 1000 children. Of those with elevated ALA, 48% had elevated blood lead, and there were no false negatives on the ALA test. The latter authors also describe a second series of 500 children in which results apparently confirm the correlation between urinary ALA and blood lead. Technical details in handling of specimens might have affected some results and are discussed.

194. Critique of interlaboratory evaluation of the reliability of blood-lead analyses—Weil C.S., Carnegie-Mellon Univ., Mellon Inst., Pittsburgh, Pa.—AMER. INDUSTR. HYG. ASS. J. 1971, 32 (304-312)

Interlaboratory comparison of the results of analytical procedures is important to delineate the presence or absence of accuracy and precision. As part of laboratory accreditation must depend on accurate analysis of the results of such interlaboratory trials, a reanalysis of the blood-lead values (Keppler *et al., Amer. Industr. Hyg. Ass. J.* 1970, *31*, 412) determined by 60 laboratories is presented. In the nonparametric procedures used, the outlying laboratories (those whose central tendency and those whose variability were abnormal) are clearly delineated. These outlying laboratories can, therefore, more easily attempt to correct their method of analysis, knowing how they compare with the majority of other laboratories.

195. δ-aminolevulinic acid dehydratase activity in circulating blood cells. A sensitive laboratory test for the detection of childhood lead poisoning—Weissberg J.B., Lipschutz F. and Oski F.A., Dept. of Ped., Univ. of Pennsylvania Sch. of Med., Philadelphia, Pa.—NEW ENGL. J. MED. 1971, 284/11 (565-569)

An inverse correlation was demonstrated between erythrocyte δ-aminolevulinic acid (ALA) dehydratase activity and blood lead levels. ALA-dehydratase activity was shown to be a sensitive index of subclinical lead poisoning, more so than either urinary coproporphyrin or urinary ALA. Enzyme levels were lower in children living in deteriorated slum housing of the inner city than in those living in better housing in urban and suburban areas. It is suggested that assays for this enzyme will serve both as a practical screening test for unrecognized plumbism among suspect populations and as an adjunct to the rapid diagnosis of acute lead intoxication.

196. Measurement of lead in blood and urine by atomic absorption spectrophotometry—Farrelly R.O. and Pybus J., Dept. of Chem. Pathol., Auckland Hosp., Auckland—CLIN. CHEM. 1969, 15/7 (566-574)

An extraction method for the estimation of lead in red cells is given. The method avoids both acid digestion and/or protein precipitation. It is extremely simple and reliable, and can easily be performed by technicians. A technical error of 4.5 μg. lead per 100 ml. of red cells has been obtained. The use of red cells instead of whole blood provides a more accurate measure of exposure to lead as the lead is concentrated within the red cells. Normal and toxic ranges are given. As it is frequently required to monitor the lead excretion of patients receiving chelates for thereapy, a method for the analysis of urine specimens from patients on this therapy is given.

197. Blood lead estimations—Edwards R.G., Berriman H. and Geary T.D., Inst. of Med. and Veter. Sci., Adelaide—PATHOLOGY (SYDNEY) 1970, 2/1 (75-76)

Whole blood or red cell lead content estimations are known to be the best indication of exposure to lead, but these measurements are not used as frequently as is desirable in Australia apparently because of the supposed technical difficulty of the laboratory methods. A simple method of estimating blood lead is presented. This can be established in any good laboratory and is based on lysis of an aliquot of blood, chelation of the lead, concentration of the complex in an organic phase and the spraying of this extract into an atomic absorption spectrophotometer. Values obtained from a group of 40 adults not exposed to a lead hazard ranged from 5-20 μg. of lead 100 ml. of whole blood with a median value of 15 μg. As lead is bound to red cells it has been recommended that results be expressed as micrograms of lead ml. of erythrocytes (mean erythrocyte lead concentration or MELC). The normal MELC range is then 0.15-0.50 μg. with a median value of 0.30 μg. Five hundred estimations on industrial workers engaged in the manufacture of car bodies and batteries gave a range of values from 5-130 μg./100 ml. and demonstrated, as would be expected, that certain activities involved more exposure to lead than others. However, some which were previously thought to have a low risk of exposure were shown in fact to have quite a high risk. Several workers had values which were regarded as dangerously high. It was also clear from discussions with the workers themselves that these values had probably been present for several years. Measurements on some workers have demonstrated the value of blood lead estimations in the rapid detection of changes in industrial exposure. The effects of blood lead levels in excess of 70 μg. on adult tissue and, in particular the nephron, has yet to be elucidated.

198. Detection by X-ray fluorescence of metals and metalloids contained in histological sections / Détection par la fluorescence X des métaux et métalloïdes contenus dans les coupes histologiques—Duprez A., Wittmann A., Rauber G. and Florentin P., Lab. d'Anat. Pathol., CHU., Nancy—C.R. SOC. BIOL. (PARIS) 1967, 161 (871-874)

X-ray fluorescence allows specific identification of the substances searched for without interfering with morphological and other studies of the histological sections. Sections 5.5 μ thick are embedded in paraffin, spread and fixed onto a mylar foil of 6 μ thickness. Following extraction of the paraffin the sections are soaked in water and subsequently dried. Then they are mounted on a support and are introduced into the X-ray fluorescence apparatus. If the presence of a certain atom is suspected, the apparatus is set for the principal rays of the corresponding atom and its presence is investigated. Following this, water is added again to the preparations which then are stained and placed between a slide and a cover glass to be studied under the light microscope. Using this method, iron was detected in the liver tissue of a patient with hemochromatosis. Copper was identified in spleen and liver of a patient with Wilson's disease. Silicon was encountered in the lung tissue of a miner with silico-asbestosis. Lead was found in the gingival mucosa of a patient with plumbism. Next to calcium and sulfur, potassium was present in all tissues analyzed of a young individual with an osteochondroma. Iodine, antimony, calcium and potassium were found in a simple goiter. This method allows the detection of all atoms whose atomic number is higher than 12. The multiple possibilities of practical application are briefly discussed.

199. A method for the determination of lead in blood by atomic-absorption spectrophotometry—Donovan P.P. and Feeley D.T., Publ. Anal. Lab., Galway Reg. Hosp., Galway—ANALYST 1969, 94 (879-883)

A method for the determination of trace amounts of lead in blood is described. The organic material in the blood is oxidized by dry ashing at 500° C and a solution of the ash in dilute hydrochloric acid prepared. The lead in the ash solution is determined by atomic absorption at 217 mm. in an air-propane flame after isolation by a double-extraction procedure with dithizone and ammonium tetramethylenedithiocarbamate as complexing agents. Recovery tests are carried out and the lead content of the blood of workers from a lead mine, determined by this method, is compared with results obtained by using the mixed color method of the Analytical Methods Committee. Comparative tests will wet-oxidation and dry-ashing techniques are made on samples of blood to which known amounts of lead have been added. The interference caused by bismuth is also investigated.

200. Tests for lead poisoning—Deutsch R.H., New York Univ. Sch. of Med., New York, N.Y.—NEW ENGL. J. MED. 1971, 285/27 (1541)

The author reports a comparison of a microfluorimetrix protoporphyrin test with microaminolevulinic acid dehydratase (ALAD) assay in detection of lead exposure. The subjects were baboons. Animals not poisoned with lead had blood lead, ALAD and protoporphyrin levels not appreciably different from those in humans with no detectable symptoms of lead poisoning. In 3 experimental animals, the high blood level (which would indicate lead poisoning in man) did not produce overt symptoms, and ALAD activity and protoporphyrin concentration remained within normal limits. High blood lead in baboons does not, therefore, necessarily indicate lead poisoning. ALAD assay and fluorimetric protoporphyrin tests were shown to be positively correlated with one another. The latter test is quicker than the former and further research to test its suitability for use in a mass screening program to detect lead exposure in disadvantaged areas is suggested.

201. Significant decrease of stippled red cells in plumbism under the influence of certain anticoagulants / Raréfaction importante des hématies ponctuées du saturnisme du fait de certains anticoagulants—Desoille H., Philbert M., Marin E., Rosignoli H. and Albahary C., Inst. d'Hyg. Indust. et de Méd. du Travail, Paris—ARCH. MWL. PROF. 1970, 31/4-5 (230-236)

It has been observed that the enumeration of stippled red cells is more difficult in heparinized smears than in smears of blood collected without the use of this anticoagulant. The aim of the present study was to ascertain whether anticoagulants other than heparin would have the same effect. Control studies were carried out on reticulocytes (proerythrocytes). Lead poisoning was induced in 80 male albino guinea pigs orally administered neutral lead acetate. Parallel studies were made of untreated blood and blood treated with: heparin; sequestrene-potassium; Wintrobe's mixture; sodium fluoride-potassium oxalate; and sodium citrate. The results are shown in 7 tables. A significant fall in the number of stippled red cells was noted under the influence of sequestrene-potassium, Wintrobe's mixture and sodium fluoride-potassium oxalate. No modification was found with the use of heparin or sodium citrate. The influence of the concentration of the anticoagulant was studied for sequestrene and Wintrobe's mixture. The diminution in stippled red cells paralleled the increase in concentration. In contrast to the stippled red cells, the number of reticulocytes was uninfluenced by addition of the different anticoagulants. The exact mechanism of the phenomenon remains obscure. Since sequestrene and Wintrobe's mixture are being used routinely in laboratory studies, their influence in the detection of plumbism is of practical importance.

202. Semi-automatic determination of lead in whole blood—Delves H.T. and Vinter P., Inst. of Child Hlth, Hosp. for Sick Children, London—J. CLIN. PATH. 1966, 19 (504-509)

The procedure developed by Browett and Moss for the semi-automatic determination of the lead content of urine has been adapted for the determination of lead in blood. Determinations are normally carried out in duplicate on 2.0 ml. samples of whole blood and the minimum sample size is 0.5 ml. The organic substances present in blood are destroyed by a manual wet-oxidation procedure and the lead is determined colorimetrically as lead dithizonate using a Technicon Autoanalyzer. The lower limit of detection, expressed as 3 times the standard deviation of the blank value, is 5 µg. lead/100 ml. blood. The standard deviation of the method in the upper range of normal blood lead level of 30 µg. lead/100 ml. blood, is ± 3 µg. lead/100 ml. blood. Ten samples per hour may be estimated in duplicate.

203. A micro-sampling method for the rapid determination of lead in blood by atomic-absorption spectrophotometry—Delves H.T., Dept. of Chem. Pathol., Hosp. for Sick Children, London—ANALYST 1970, 95 (431-438)

The concentrations of lead in 10-µl. samples of whole blood are accurately determined in less than 5 minutes by atomic-absorption spectrophotometry. After partial oxidation with hydrogen peroxide in micro crucibles made from nickel foil, the samples are volatilized, by using an air-acetylene flame, into a nickel absorption tube situated in the flame. The sensitivity of the method is 1 x 10^{-10}g. of lead per 1% absorption at 283.3 nm., and the standard deviation if ± 4% at the 3 ng. level. Thirty-nine blood samples with lead concentrations ranging from 19 to 245 µg./100 ml. were analyzed by the method described and by automated colorimetry involving the use of dithiozone. The correlation coefficient between the results of both methods was 0.989.

204. Urinary delta-aminolevulinic acid (ALA) levels in lead poisoning. II. Correlation of ALA values with clinical findings in 250 children with suspected lead ingestion—Davis J.R., Abrahams R.H., Fishbein W.I. and Fabrega E.A., Dept. of Pharmacol. and Therapeut., Loyola Univ. Stritch Sch. of Med., Hines, Ill.—ARCH. ENVIRONM. HLTH 1968, 17/2 (164-171)

The method for the determination of urinary δ-aminolevulinic acid (ALA) from random urine samples has been modified utilizing a dual disposable chromatographic column unit prefilled with resin that can be conveniently held in a support rack over a drain tray. The present procedure now permits one individual to perform as many as 1000 analyses of urinary ALA in a normal working week. A single-blind evaluation was made of the laboratory findings and clinical impression of increased lead exposure versus the urinary ALA levels obtained in each of 250 children suspected of lead ingestion. It was found that the incidence of a correct correlation between urinary ALA and the clinical diagnosis of increased urinary ALA and the clinical diagnosis of increased lead exposure was 91%. None of the other laboratory tests studied had a comparable degree of accuracy for the detection of early lead exposure.

205. **A simple rapid test for lead poisoning**—Qazi Q.H. and Madahar D.P., State Univ. of New York, Downstate Med. Cent., Brooklyn, N.Y.—J. PEDIAT. 1971, 79/5 (805-808)

The test described in this communication utilizes the phenomenon of osmotic resistance of erythrocytes in lead poisoning and could be used for detection of children with an increased lead burden. Preliminary observations suggested that it can identify more than 85% of children with blood lead levels of 0.06 mg./100 ml. or higher, and a higher percentage of children with blood lead levels of 0.09 mg./100 ml. and higher. The test is rapid, simple to perform, requires only 0.04 ml. of blood, and utilizes reagents and equipment available in almost any laboratory.

206. **A microquantitative method for determining mercury in the urine by means of impregnated chromatographic paper (Bulgarian)**—Nikolcheva Ya.—HIG. ZDRAVEOP. (SOFIA) 1966, 9/6 (591-594)

A method for determining mercury in the urine is presented. The organic substances are decomposed using a mixture of H_2SO_2 and HNC_3, both in concentrated form. Ditizone is used for extraction of the mercury. The quantity of mercury can then be determined with Whatman paper No. 1 impregnated in molybdenylferrocyanide. The methods for the preparation of the paper and for the quantitative determination are discussed.

207. **Fluorescence of erythrocytes in relation to erythrocyte protoporphyrin and to urinary lead excretion**—Nelson J.D., Dorn P., Rogers L.E. and Sartain P., Dept. of Ped., Univ. of Texas Southwestern Med. Sch., Dallas. Tex.—AMER. J. CLIN. PATHOL. 1968, 50 (297-301)

Estimation of the percentage of erythrocytes which fluoresce when stimulated with near ultraviolet light was made in 927 patients. Increased fluorescytosis was found in 97% of patients with proved lead poisoning and in only 1.8% of patients without other historical or laboratory evidence of lead poisoning. Comparison of the percentage of fluorescytes and the urinary lead excretion after stimulation with calcium disodium EDTA in 89 specimens revealed that only one patient with increased lead excretion failed to show increased fluorescytosis. Quantitative erythrocyte protoporphyrin determinations were performed in 35 patients. Of 23 patients with normal values (≤ 50 μg./100 ml. of packed red blood cells), 21 had 1% or fewer fluorescytes and two had 2 to 5% fluorescytes. In 6 specimens with slightly elevated values (60-223 μg./100 ml. of packed RBC), there were fewer than 10% fluorescytes. All 6 patients with the markedly increased erythrocyte protoporphyrin (570-2416 μg./100 ml. of packed RBC) of lead poisoning lead over 50% fluorescing erythrocytes. These observations confirm the assumption that increased erythrocyte protoporphyrin is responsible for the fluorescence of peripheral red blood cells.

208. Enhanced potassium loss in blood cells from men exposed to lead—Hasan J., Hernberg S., Metsälä P. and Vihko V., Inst. of Occupational Hlth, Helsinki—ARCH. ENVIRONM. HLTH 1967, 14 (309-312)

Blood samples were collected from 7 shipyard workers exposed to lead oxide paint and from 7 nonexposed control subjects. No signs or symptoms of lead poisoning could be detected in the exposed men, and the concentration of lead in their blood did not exceed 0.07 mg./100 ml. During incubation in a heparinized glass tube at 37C for 2 hours, the concentration of potassium in the plasma of blood samples from the control group consistently decreased by 0.19-0.62 mEq./l.; it decreased in the blood sample of one exposed worker by 0.17 mEq./l. In the blood samples of 7 of the exposed workers, the concentrations of potassium, under identical conditions, increased by 0.34-1.38 mEq./l. No differences could be demonstrated between the mean potassium concentrations in the red cells samples from the 2 groups. Essentially similar results were obtained in samples from 7 control subjects and 7 of the same exposed workers after an interval of 4 months. No systematic differences were observed between the changes in sodium concentration in the blood samples from exposed and nonexposed workers. The results are interpreted as reflecting a deficiency in the functional capacity of erythrocytes of men exposed to inorganic lead, revealed by the load imposed on the cells by the incubation *in vitro.*

209. A simple rapid method of determining the approximate serum iron level in acute iron poisoning—Hosking C.S., Dept. of Pathol., Univ. of Queensland—MED. J. AUST. 1969, 1 (981-982)

A simple method is described to determine whether or not the serum iron level is significantly raised in acute iron poisoning. The method depends on the fact that trivalent iron is bound by desferrioxamine and the resultant compound, ferioxamine, is colored.

210. Determination of lead in hair by atomic absorption spectroscopy for simple screening of lead intoxication—Hasegawa N., Hirai A., Shibata T., Sugino H. and Kashiwagi T., Res. Inst. of Environm. Med., Nagoya Univ., Nagoya—ANN. REP. RES. INST. ENVIRONM. MED. (NAGOYA UNIV.) 1971, 18 (1-5)

The analysis of lead in hair segments was described. In most cases a good correlation was observed among clinical and laboratory findings and the occupational history of the patient. This analysis may provide a simple screening method in health control in the case of lead workers who are exposed to possible lead poisoning. The time exposure to lead was calculated.

211. Evaluation of two methods for measuring δ-aminolaevulinic acid in urine—Haeger-Aronsen B., Dept. of Med., Malmö—SCAND. J. CLIN. LAB. INVEST. 1970, 25 (19-23)

The concentration of δ-aminolevulinic acid in the urine is known to be a good measure of the degree of lead intoxication. The first methods for quantitative determination of the acid were laborious but have since been simplified. One of these modifications, the one described by Grabecki *et al.* was compared with the technique originally elaborated by Mauzerall & Granick. It was found that the former procedure was as reliable as the latter, and both quicker and cheaper. The modification by Grabecki *et al.* is therefore recommended in the control of lead workers.

212. δ-aminolevulinic acid determination in urine by continuous flow and sequential automatic analyzers / Determinazione dell'ALA nelle orine mediante analizzatori automatici a flusso continuo e sequenziali—Grisler R., Genchi M. and Perini M., Clin. del Lav. 'Luigi Devoto', Univ. di Milano—MED. D. LAVORO 1967, 60/11 (678-686) δ-aminolevulinic acid determinations in urine were carried out according to the method of Grabecki *et al.* both by the Technicon Autoanalyzer, a representative of the 'flow system', and by the Clino-Mak Analyzer, a representative of the 'discrete system'. Both automatic analyzers can perform 35 analyses in 1 hour and 90 in 2; moreover by the Technicon Autoanalyzer 155 analyses can be done in 3 hours and 275 analyses in 5 hours. The results are satisfactorily reproducible. The sensitivity, lower than 0.5 mg./100 ml. allows to make determinations also on urine of normal subjects. Therefore the automatic determination of the urinary δ-aminolevulinic acid can be largely used in industrial preventive medicine, as a quick and reliable test for the control of the degree of exposure to lead adsorption.

213. Clinical validity for the diagnosis of lead poisoning of a new hematologic index: the average red blood cell concentration of lead / Validita' clinica per la diagnosi di saturnismo di un nuovo indice ematologico: la concentrazione eritrocitaria media del piombo—Grisler R. and Farina G., Clin. del Lav. 'Luigi Devoto', Univ. di Milano—MED. D. LAVORO 1967, 60/5 (360-365)

The average red blood cell concentration of lead, that is the average amount of lead present in the single erythrocyte, calculated by the ratio between the blood lead value and the hematocrit, was studied with the aim of evaluating its usefulness for the diagnosis of saturnism. The values of such concentration in normal subjects of the Italian population are lower than 1.30 with a probability of 95.45%; the maximum normal value of the concentration is 1.66. When compared with the blood lead levels, the values of the average erythrocyte lead concentration in 98 saturnine patients showed a higher agreement, statistically significant, with the urinary lead values in basal conditions and after administration, with the presence of basophilic stippling and of the erythrocyte protoporphyrin IX. The authors propose to calculate the average erythrocyte concentration of lead at the same time of the blood lead determination, and to consider the values higher than 1.30 as highly suspicious for an abnormal lead absorption; this pathologic condition would be certain for values higher than 1.66.

214. Analysis of human hair by spark source mass spectrometry—Yurachek J.P., Glemena G.G. and Harrison W.W., Dept. of Chem., Univ. of Virginia, Charlottesville, Va.—ANALYT. CHEM. 1969, 41 (1666-1668)

An A.E.I. MS 702 spark source mass spectrometer was used to analyze the contents of a number of elements in human hair, including lead, iron, copper, zinc, arsenic, magnesium and silver. Hair samples of about 100-1000 mg. were ashed at 450°C and mixed with very high purity silver powder and graphite to produce an electrode source. Yttrium oxide was also added as an internal standard. Very small samples of hair, in the order of 10-100 mg., were wet-ashed with nitric acid and with the subsequent addition of perchloric acid. This wet-ashed material was dried and used to prepare and electrode source. With some reservations, the technique appeared to give reasonably reproducible results. Thus the lead content in 3 aliquots of one hair sample was assayed at 52, 47 and 45 μg./g. dry weight, respectively. Some of this variation may have been due to a variation of the lead content in the hair itself, but some of it was due to experimental error. The method is therefore suitable for the determination of elements in hair, which may reflect the long-term status of some trace elements in the body, and is especially significant in detecting excesses of toxic metals such as lead.

215. Determination of lead in urine by atomic absorption spectroscopy using coprecipitation with bismuth—Kopito L. and Shwachman H., Child. Cancer Res. Found., Boston, Mass.—J. LAB. CLIN. MED. 1967, 70/2 (326-332)

Lead is separated from urine by coprecipitation with bismuth nitrate preparatory to analysis by atomic absorption spectroscopy. The procedure may be used in determining lead in freshly voided specimens and also in partially decomposed urines. The presence of bismuth in the analyte is compatible with the analysis and suppresses interferences from sodium, potassium, calcium, magnesium, and phosphates. This determination is relatively simple, rapid, and may be performed in a routine clinical laboratory. Single determinations can be done in about 15 minutes and a run of 10 determinations per hour. Lead, added to urine in quantities of up to 100 μg./l. is recovered with a precision of 99% and a standard deviation of 4.5%. In patients with lead poisoning undergoing therapy with chelating agents, this procedure is not suitable nor is it necessary since the urine contains sufficient lead to be determined directly without prior concentration. Since the summer of 1964, this method has been used in confirming the diagnosis of plumbism in 24 children. Over 100 urine specimens obtained from patients with other diseases and healthy individuals served as controls.

216. Lead in hair of children with chronic lead poisoning—Kopito L., Byers R.K. and Shwachman H., Dept. of Clin. Pathol., Child. Cancer Res. Found., Boston, Mass.—NEW ENGL. J. MED. 1967, 276/17 (949-953)

A procedure for the analysis of lead in hair is described. The results, based on differences in the lead levels of adjacent hair segments or considerably elevated concentrations, or both, provide an additional means for confirming the diagnosis of chronic plumbism in children. Good correlation is observed with the major clinical and laboratory findings. This method is most useful when used in conjunction with the radiographic observations and other laboratory data, particularly when these are equivocal and of nondiagnostic quality. Because hair is readily available and easy to obtain, this measurement may provide a simple means for screening children exposed to possible lead intoxication. The procedure described is not suitable for establishing the diagnosis of acute lead intoxication.

217. A polarographic method for the simultaneous determination of lead and cadmium in urine—Knockaert O.E., Maes G.L. and Faes M.H., Dept. of Indust. Med., Cent. for Study of Nucl. Energy, Mol—AMER. INDUSTR. HYG. ASS. J. 1967, 28 (595-598)

This polarographic method for simultaneous determination of urinary lead and cadmium employs one container for ashing, chemical separation, centrifugation and polarographic recording. It covers a range from ∼ 10 μg./l. to high concentrations. Full details are given. Ashing is effected with a mixture of sulfuric and perchloric acids. Most satisfactory results are obtained by ashing in the presence of nitric and perchloric acids with perchloric acid used in quantities sufficient to minimize the explosion hazard. Residue is purified by precipitation reactions. The best results were obtained with precipitates of mixed crystals of Sr and Pb sulfates. The disadvantages are that several centrifugations and large amounts of ethanol are needed. This can be avoided by using phosphate precipitations although recoveries thus obtained are less. Presence of iron at concentrations of 1 mg./l. makes analysis of microgram quantities of lead and cadmium difficult. Urine never normally contains this amount of iron, though blood does. Acidification at the precipitation step eliminates all elements but lead, but gives low recoveries. Details of possible interference by copper, bismuth and thallium are given with methods of preventing this interference. Results of testing of 1111 urines of workers occupationally exposed to lead and 175 urines of workers occupationally exposed to cadmium are given.

218. Determination of lead chelated with ethylenediaminetetra-acetic acid in blood after precipitation of protein with perchloric acid—Cernik A.A., Med. Branch, H.M. Fact. Inspectorate, Dept. of Employm. and Productivity, London—BRIT. J. INDUSTR. MED. 1970, 27 (40-42)

A method is described for the determination of lead in whole blood containing ethylenediaminetetra-acetic acid. Proteins were precipitated by 2·0 M perchloric acid. The ionized lead in the supernatant was chelated with ammonium pyrrolidine dithicarbamate and was extracted with xylene. The method agreed well with a dry ashing technique (30 samples, correlation coefficient 0·985). Perchloric acid gave consistently good recoveries, unlike trichloroacetic acid, which frequently produced losses of up to 15%.

219. Fast hemoglobin in lead poisoning—Charache S. and Weatherall D.J., Dept. of Med., Johns Hopkins Univ. Sch. of Med., Baltimore, Md.—BLOOD 1966, 28/3 (377-386)

An electrophoretically fast hemoglobin was found in approximately 40% of preschool children with elevated blood lead levels. Fast hemoglobin was found more often in lead-poisoned patients with hypochromic anemia than in patients with normochromic red cells. It differed from hemoglobins produced *in vitro* by incubation with chromate or oxidized glutathione. It had electrophoretic properties similar to that found in a few patients receiving tolbutamide. A differentiation could not be made between fast hemoglobin and normal hemoglobin A_3 by any technic utilized. Both lead and A_3 hemoglobins were heterogeneous molecular species. The mechanism leading to the production of hemoglobin A_3 and lead hemoglobin remain unknown.

220. Determination of δ-aminolevulinic acid in plasma—Chisolm Jr J. J., Dept. of Ped., Johns Hopkins Univ. Sch. of Med., Baltimore, Md.—ANALYT. BIOCHEM. 1968, 22 (54-64)

A method for determination of δ-aminolevulinic acid (ALA) in plasma is reported. The procedure is adapted from an ion-exchange resin chromatography procedure for determination of ALA in urine. Normal fasting children and fasted patients with symptomatic lead intoxication and acute intermittent porphyria were studied. The mean normal value found in healthy subjects is 0.056 μg./ml. This method is best suited to the study of acutely ill patients in whom the concentration of ALA in plasma is increased by 4- to 40-fold.

221. A screening method for copper and lead in urine—Chiu G., Ma L. and Chang H.M., Dept. of Chem., United Coll., Chinese Univ. of Hong Kong—MIKROCHIM. ACT. (WIEN) 1968, 6 (1224-1228)

A method for screening copper and lead in urine is described. The heavy metals are extracted from urine using a chelating ion exchange resin, and subsequently separated by paper chromatography. By comparing the color intensities of the metal dithizonates developed from the standards and the samples, a semiquantitative measurement can be made.

222. Emergency semiquantitative estimation of plasma iron concentration—Cooper H.A., Ekblad M.D. and Fairbanks V.F., Mayo Grad. Sch. of Med., Univ. of Minnesota, Rochester, Minn. AMER. J. DIS. CHILD 1971, 122 (19-21)

A rapid semiquantitative method for early diagnosis of iron poisoning is described using iron-free glassware, one drop each of tripyridyltriazine and thioglycolic acid are added to one ml. of citrated plasma and the resultant color is compared with a graded color chart.

The method takes only 10 minutes to complete and the results correlate well with conventional spectrophotometric methods for plasma iron levels of less than 500 μg./100 ml. Since plasma iron levels of 300 μg./100 ml. in young children indicate the need for vigorous therapy this estimation permits the rapid institution of such therapy. The method can also be used to test gastric aspirates to confirm suspected iron ingestion.

Treatment and prevention

223. Treatment of acute iron poisoning—Robertson W.O., Univ. Hosp., Seattle, Wash.—MOD. TREATM. 1967, 4 (671-678)

Acute iron poisoning is one of the most common lethal poisonings today due to the widespread prescription of iron preparations for real or imagined anemia. It occurs exclusively in children, no case having yet been reported in an adult. Overdosage of iron exerts both local and systemic effects. There is rapid necrosis of the mucosa of the gastrointestinal tract and subsequent severe hemorrhage. At the same time absorbed iron soon exceeds binding capacity and it is sequestered in the liver and spleen where it is a potent protoplasmic poison. A severe metabolic acidosis develops rapidly. The elevated serum iron interferes with clotting and augments the hemorrhagic process. Typically symptoms begin with vomiting followed by lethargy, shock, metabolic acidosis with its respiratory consequences, liver failure and deepening coma. Treatment is directed towards removal of iron from the gastrointestinal tract, from the plasma and from intracellular locations. The chelating agent deferoxamine has strong selective affinity for ferric iron with any affinity for calcium. In addition general supportive therapy is necessary. Exchange transfusion has been performed for acute iron intoxication but its value remains in doubt.

224. Treatment of lead poisoning—Chisolm Jr J.J., Dept. of Ped., Johns Hopkins Univ. Sch. of Med., Baltimore, Md.—MOD. TREATM. 1967, 4 (710-727)

Following a number of general remarks on plumbism, the author discusses childhood lead poisoning. Effective therapy depends on early diagnosis and treatment of acute episodes, permanent separation of the child from environmental lead sources, and prevention of pica. Since acute encephalopathy can develop with unpredictable rapidity, any child with symptoms suggestive of plumbism should be hospitalized immediately. Early diagnosis is dependent upon a high index of suspicion, a knowledge of the epidemiology of plumbism and interpretation of specific laboratory tests. These 3 items are discussed at length and the laboratory determinations required for diagnosis are tabulated. Treatment comprises supportive measures and chelation therapy with dimercaprol, EDTA and penicillamine. Dosage schedules are given, possible side effects are described and the necessary precautions are listed. Convalescent and long-term care are gone into. The second part of the paper deals with adult lead intoxication. Here, industrial exposure is the chief hazard. Nonindustrial types of exposure are listed in a table. The laboratory parameters used in industry for medical supervision are summarized. Principles for the use of chelating agents are essentially the same as in the child. Indications for chelation therapy and dosage are presented. In the author's opinion combined dimercaprol-EDTA followed by penicillamine is indicated whenever blood lead exceeds 100 μg./100 g. whole blood even in the absence of clinical symptoms. Intoxication due to organic lead compounds (tetraethyl lead and tetramethyl lead) occurs in the petroleum industry. Illness begins acutely with psychotic symptoms. Urinary lead excretion is very elevated but blood lead is only slightly high. No specific therapy is available and the mortality rate is approximately 20%.

225. Medical aspects of childhood lead poisoning—HSMHA HLTH REP. 1971, 86/2 (140-143)

The US Public Health Service recommends a screening program for lead poisoning in children aged 1-6 years living in poorly maintained houses. Lead paint was often used for interior decoration up to 1940 and is still used externally. Plumbism can be prevented by early detection of the risk. The range of blood-leads found in the US urban population is 15-40 μg./100 ml. All children with levels of 50-79 μg./100 ml. who are not diagnosed as having lead poisoning should be closely followed and supervised, and also children under 3 years of age with levels of 40-49 μg./100 ml. Children with levels of 80 μg. or more per 100 ml. should be treated as emergencies, whether or not they have any signs or symptoms of poisoning. Chelating agents should be used because 40% of such children will sustain permanent brain damage if they develop encephalopathy. When anorexia, constipation and cholic occurs without obvious cause, lead poisoning should be considered. Additional evidence is: (1) a 24-hour urinary excretion of more than 1 μg./ml. lead of Ca-EDTA given intramuscularly at a dosage of 50 ml./kg. bodyweight; (2) a serum δ-aminolevulinic acid level over 20 μg./100 ml.; (3) a 24-hour urinary coproporphyrin output of over 150 μg.; (4) a 24-hour urinary output of δ-aminolevulinic acid over 5 mg.; and (5) basophil stippling of the red cells and radiological evidence of 'lead lines' in the long bones, or a strongly positive urine spot test for coproporphyrin. When lead poisoning is suspected or discovered, the source of lead exposure should be removed and the child followed up for at least 6 years. Confirmed cases must also be reported to the local health authority.

226. Lead poisoning in children—J. ARKANSAS MED. SOC. 1970, 56 (290)

The hazard to man's health from the use of lead in industry has been recognized for several generations. Only in the last 2 decades have health workers begun to realize that lead poisoning of children in cities is a problem of great magnitude. The widespread lead poisoning in children basically involves toddlers who have abnormal appetites, leading them to act numerous nonfood items. Pica forms an essential linkage in making lead poisoning the problem that it is. Access to crumbling lead paint is most common in older, usually rundown housing. Lead poisoning is a preventable disease requiring a joint effort among health workers, physicians, social workers, housing authorities and parents. One of the first preventive measures sought was elimination of lead-based paints in housing interiors. Since 1955, the American Standards Association has recommended that only paint with 1% of lead content or less be considered for safe use on children's toys, furniture and housing interiors. Builders of modern structures have generally followed this recommendation for interiors. Hence the problem is minimal in modern homes, while it remains a threat in older, dilapidated houses. Housing authorities can enforce housing codes to spur repair or elimination of undesirable housing. Parents need to see that chipping and peeling paint is removed from all interior surfaces, and that they are repainted with a safe non-lead-based paint. Children should also be prevented from chewing or eating foreign objects. Finally, providing the child with safe, interesting toys as well as the parental attention that all younger children require can do a great deal to prevent this disease.

227. Treatment of toxic and drug induced neuropathies—Afifi A.K. and Sabra F.A., Dept. of Int. Med., Div. of Neurol., Sch. of Med., Amer. Univ. of Beirut—MOD. TREATM. (N.Y.) 1968, 5/6 (1236-1248)

General treatment of toxic polyneuropathy includes removal of the toxin and treatment of the neuritis as well as symptomatic therapy. Arsenic neuropathy may follow acute or chronic poisoning. Arsenic is thought to react with an essential thiol group thereby inactivating one of the components of the pyruvate and α-ketoglutarate oxidase enzyme system. Treatment with dimercaprol is required for at least 10 days and generally the course of the disability is a long one with permanent crippling in the most severe cases. Lead neuropathy is much commoner in adults than in children. Dimercaprol is of no value in its treatment but calcium disodium EDTA and penicillamine are more effective. Mercury neuropathy is most commonly due to ingestion of mercury in teething powder, calomel anthelmintics or absorption from ammoniated mercury ointment and mercury bichloride diaper rinse. Dimercaprol in large doses as soon as possible after ingestion is effective in acute poisoning. Thallium neuropathy results either from accidental ingestion of rodenticides or insecticides or industrially in the manufacture of sulphuric acid from iron pyrites. Treatment is general.

228. Chelation therapy in acute iron poisoning—Leikin S., Vossough P. and Mochir-Fatemi F., Dept. of Ped., George Washington Univ. Sch. of Med., Washington, D.C.—J. PEDIAT. 1967, 71/3 (425-430)

Deferoxamine, a highly specific iron chelating agent, was used in association with supportive therapy in 14 children with acute iron intoxication of mild to moderate severity. The serum iron levels and iron excretion of these patients were compared with those of 8 patients who received only supportive therapy. A rapid drop in serum iron levels occurred in both groups. Increased urinary excretion of iron occurred in patients receiving deferoxamine. All of the children recovered. It is recommended that this chelating agent not be used routinely in mild cases of iron intoxication.

229. Treatment of acute iron ingestion with deferoxamine in 20 children—McEnery J.T. and Greengard J., Hektoen Res. Inst., Dept. of Ped., Cook County Hosp., Chicago, Ill.—J. PEDIAT. 1966, 68/5 (773-779)

The use of deferoxamine in acute iron poisoning is discussed and details are given for the management of cases of such poisoning with this drug.

230. Deferoxamine as a chelating agent—McEnery J.T., Dept. of Ped., Cook County Child. Hosp., Chicago, Ill.—J. PEDIAT. 1968, 72/1 (147-148)

Deferoxamine has been recommended as a chelating agent only in severe cases of iron poisoning. It is usually not possible to accurately determine how much iron has been ingested but most cases treated involve mildly to moderately sick children. Some of these children might have died if the iron in excess of the binding capacity of the iron-binding protein had not been chelated. No toxic effects have been observed with oral deferoxamine, although used intravenously it has produced shock when administered rapidly. The rate of 15 mg./kg./hour now recommended appears to be safe. Depending on their size and degree of pre-existing anemia, children can tolerate serum iron levels of 500 γ %, but the higher the initial serum iron level, the more likely the child is to be lethargic or in shock. It is these patients who excrete pink colored urine while receiving 90 mg./kg. of deferoxamine in a continuous intravenous drip. This test has helped in the evaluation of the need for additional chelating therapy before serum iron results are available. The child who is not too sick initially may be the one who dies during the later phase of acute iron overload of the liver enzyme systems. This should be preventable by the use of chelating agents, of which the best available is deferoxamine. A table is given to show the level of iron in 24-hour urine collection in relation to the pre-treatment serum iron levels in 38 children treated with chelating agent. It demonstrated a correlation between pink-colored urine and high pre-treatment serum iron levels.

231. Prevention of childhood poisoning. A community project—Scherz R.G., Madigan Gen. Hosp., Tacoma, Wash.—PEDIAT. CLIN. N.-AMER. 1970, 17/3 (713-727)

The approach to the problem of accidental poisoning should be a community one with close collaboration between the poison control center, local health department, communications media, schools, doctors, pharmacists, public health nurses, social workers and family units. Poison control centers can supply vital information about the types of poisonings occurring, to whom and how frequently. The doctor, in addition to treating the patient, should be aware of the risks of repetition and caution the child's parents, arranging, if necessary, for them to be visited by a public health worker. He should also see that his prescriptions are properly labeled. The pharmacist, by insisting on safety precautions and spreading information, is in a position to prevent many cases of childhood poisoning. Nurses and social workers also have an educative role in prevention. In the US the mass media have been used in public education programs designed to create an awareness of the dangers of accidental poisoning. It is the pre-school child who is at greatest risk, so educational programs for the child of school age will be informational rather than preventive, a way of reaching parents and pre-school siblings. Some community programs have been concerned with specific poisoning problems, particularly lead poisoning from paint in old housing. Safety packaging has helped to reduce poisoning from prescription medications and there is a growing use of child-resistant containers (CRCs). There is evidence to show that the rate of poisoning from substances packed in CRCs is lower than the general average and two-thirds of the cases which did occur were due to a misuse of the CRCs. Safer packaging is not, however, a substitute for parental vigilance, child guidance or safe storage principles.

232. Ambulatory treatment of lead poisoning: report of 1155 cases—Sachs H.K., Blanksma L.A., Murray E.F. and O'Connell M.J., Lead Poisoning Clin., Chicago Board of Hlth, Chicago, Ill.—PEDIATRICS 1970, 46/3 (389-396)

Subjects with lead concentrations greater than 50 μg./100 ml. whole blood were referred to a municipal lead poisoning clinic for evaluation. Chelating agents were administered when 2 blood-lead levels were more than 50 μg. or EDTA provocative test yielded over 1000 μg./l. of lead in the urine in the succeeding 8 hours. Therapy was on an ambulatory basis. Patients with moderate encephalopathy were hospitalized. Intramuscular EDTA, oral penicillamine, or the 2 drugs in sequence were given to 582 patients in 1967 and to 573 patients in 1968. Clinical evidence of lead intoxication was present in 103 or 8.9% of the 1155 patients. Several drug reactions to penicillamine were observed, but none to EDTA, and mortality dropped due to early detection and detoxification of subclinical cases of lead poisoning.

233. Acute iron poisoning—Bachman D.S., Nat. Inst. of Hlth, Bethesda, Md.—J. PEDIAT. 1971, 78/2 (367-368)

Treatment of acute iron poisoning is discussed. It is pointed out that gastric lavage often fails to remove particulate matter from the stomach. The relative merits of ipecac-induced emesis are then considered. It is felt that the latter is more effective in producing the prompt emptying of the stomach which is the first priority in treatment. And for iron poisoning specifically induced emesis is preferable to lavage.

234. Acute iron poisoning in children: role of chelating agents—Barr D.G.D. and Fraser D.K.B., Dept. of Med. Paed., Roy. Hosp. for Sick Child., Edinburgh—BRIT. MED. J. 1968, 1/5594 (737-741)

Sixteen cases of accidental iron ingestion treated with diethylenetriamine penta-acetic acid (DTPA) or deferoxamine are described in detail. One fatality was associated with delay in the onset of specific chelation therapy. In 3 severe cases recovery was associated with large excretions of iron. Chelation data in apparently mild poisoning showed that 2 out of 12 cases excreted large amounts of iron, suggesting that potentially more severe intoxication had been averted. No toxic effects attributable to DTPA or deferoxamine occurred. At follow-up one severe case had possible neurological sequelae. There were no instances of gastrointestinal stenosis. From these results and a review of the literature it can be concluded that these drugs are biochemically effective, are largely free of side effects, and have probably improved the prognosis for survival and morbidity. Further evidence is needed from cases of severe iron intoxication.

235. Chelating agents in treatment of lead intoxication—Freeman R., Dept. of Paed., Prince of Wales Hosp., Sydney—J. PEDIAT. 1969, 74/2 (322-324)

Lead poisoning in children in Australia is discussed in two letters. In Queensland there is no legislation restricting the use of lead paint and the number of children affected is increasing, there having been 42 cases in the last 5 years. For the last 18 months all have received long-term treatment with d-penicillamine. Possibly this treatment of children or young adults may avoid chronic lead nephropathy later in life. Criteria for termination of this therapy are not yet established. Chronic renal disease may follow childhood plumbism in Queensland, though apparently not elsewhere. This difference may be related to climate and/or nature and duration of exposure, or to the duration of follow up. Use of blood lead concentration, endogenous urinary lead excretion and the EDTA mobilization test is discussed. The latter is probably the most reliable index of increased body burden of lead. Data are presented showing that in patients with impaired renal function the EDTA test should include a 4-day collection period but that 24 hours suffices where renal function is normal. The test needs standardization, for results are affected by dose, rate and route of administration. It is not known what proportion of lead excreted in this test is mobilized from storage depots and what from transient recently increased absorption.

236. Experiments with different antidotes in acute poisoning by different mercury compounds. Effects on survival and on distribution and excretion of mercury—Swensson A. and Ulfvarson U., Clin. of Occupat. Med., Karolinska Sjukh., Stockholm—INT. ARCH. GEWERBEPATH. GEWERBEHYG. 1967, 24/1 (12-50)

In these investigations, the treatment of acute poisoning with mercury compounds of different types, with dimercaprol, d-penicillamine, Rongalite C, and thioctic acid, produced an increase in the survival rate. The effect of PAS in one case may have been due to a chance variation, and needs to be checked before it can be accepted as definitely established. The other antidotes studied had no life saving effect. The therapeutic effect of an antidote varied, and depended upon the type of mercury compound that had caused the poisoning. There were also great differences between the various antidotes used with regard to their influence on the excretion of mercury and its distribution between the different organs. As a general assessment, it might probably be stated that, on the whole, ascorbic acid had no essential effect. When dimercaprol and thiomalic acid were used, all the mercury compounds studied showed an increased excretion, which corresponded to certain similar decreases in the content of the organs. For the other antidotes, the results varied more. It is important to point out that treatment with dimercaprol, thioctic acid, Rongalite C, and thioacetamide caused, in several cases, an increase in the mercury content of the brain, even in cases in which there was increased mercury excretion as a result of treatment. In view of the sensitivity of the CNS to mercury, this is a very important observation in regard to practical therapy. With certain antidotes, for example, thioctic acid, thioacetamide, and PAS, a diametrically opposed effect on excretion was observed in the case of mercuric nitrate and phenyl mercury hydroxide. This may probably be interpreted as indicating that these compounds behave in an entirely different way in the body, and that the phenyl mercury compound, at any rate during the short duration of the experiment, remained mainly intact. A persistent characteristic throughout was that the methyl mercury compound was less affected by the administration of the antidotes than were the rest of the mercury compounds studied. In this case, the strongest effect was produced by thiomalic acid. It is apparent that an increase in the survival rate need not be tied to an increase in the excretion of mercury or even to an increase or decrease in the mercury content in a certain organ. When a therapeutic effect occurs, it is probable that the mercury ion or mercury complex is detached from its cellular bond and, instead becomes bound to the antidote, as a basis for the therapeutic effect. This new compound, however, does not necessarily have to be conveyed away. Conversely, it is conceivable that some mercury is removed from an organ, but at the same time there is a redisposition in the cells, which may cause a more injurious condition in the organ than when the content was greater, and thereby increase mortality despite the decrease in the mercury content in the organs, especially when it is in a critical organ.

237. **Philadelphia combats 'silent epidemic' in the ghetto. Lead poisoning control**—Tyler R.L., Dept. of Publ. Hlth, Accident Control Sect., Philadelphia, Pa.—J. ENVIRONM. HLTH 1970, 33/1 (64-71)

The fight to prevent lead poisoning in children living in the 'lead belt' of Philadelphia is described. Substantial numbers of children still sustain brain damage in this way. Lead poisoning has been reportable in Philadelphia since 1950. A program designed to control lead poisoning has been set up, and in 1966 an ordinance was passed declaring lead paint to be a health hazard and prohibiting its use where this could be a danger to children. The source of lead is investigated in each case where blood lead exceeds .04 mg./100 g. blood, and children with pica are followed up. Details of legislation, system of reporting and investigations are given. Issuing orders for removal of hazardous paint, with court action where necessary, have achieved a compliance rate of 79%, and damage to children has been substantially reduced. From 1964-1968, there was an average of 155 cases and 2 deaths annually; from 1956-1960, corresponding figures were 45 cases annually, with 7 deaths over the whole 5-year period. In 1969 a comprehensive plan to eradicate lead poisoning in Philadelphia, based on a resolution passed by the American Public Health Association, involving citizen groups and a preventive program, was discussed. Details of this prospective scheme are given.

238. **Ten years penicillamine / Zehn Jahre Penicillamin**—Werner T. and Weinmann H.M., Kreiskrankenh., Landau/Isar—MED. KLIN. 1966, 61/46 (1827-1831)

The amino acid penicillamine was detected in 1953 by Walshe in the urine of patients with hepatic disease who had received penicillin. The free SH group present in this substance prompted Walshe to try the use of penicillamine in heavy metal poisoning and in Wilson's disease with the intention of binding the free metal and eliminating it from the system. The trial was successful. A critical review is presented of the experience gained with the use of penicillamine during the past decade. There are 2 isomers of penicillamine. The L-form is extremely toxic while the D-form is almost nontoxic. Its great affinity to heavy metals endows it with important therapeutic properties. In Wilson's disease penicillamine is capable of eliminating large quantities of the abnormal copper deposits. The practical application of the drug is discussed in detail. Chronic lead poisoning is favorably influenced by penicillamine. The same applies to gold intoxication. In cystinura, penicillamine enhances the solubility and elimination of cystine. Penicillamine therapy in other diseases like macroglobulinemia, rheumatoid arthritis, melanosis and schizophrenia is still in the experimental stage. Side effects observed so far consist of skin eruptions, febrile reactions, nephrotic symptoms, leukopenia, thrombocytopenia and vitamin B_6 deficiency. All these side effects occur infrequently.

239. **Code of safety requirements of children's toys and playthings**—BRIT. STDS. INST. NO. BS 3443 1968, 13 pages

The scope of the BSI code covers general safety requirements for children's toys and playthings but does not include items such as table-tennis balls, air guns or fireworks, which involve risks inherent in themselves. The requirements cover provide inflammable and extractable materials, metal edges, other construction materials for toys, and other things, and the obligation of manufacturers to instruction, for use and packaging materials. Among the extractable materials, prescribed in the Safety Regulations 1967, the requirement for lead states that a toy shall not have any coating of paint which contains lead, or any compound of lead, in a proportion (by weight) of lead, calculated as the element, exceeding 11,000 parts (or, after 31st October 1968, 5000 parts) in 1,000,000 parts of the dry paint film.

240. **Acute iron poisoning. Reply**—James J.A., Los Angeles County-Univ. of Southern California Med. Cent., Los Angeles, Calif.—J. PEDIAT. 1971, 78/2 (367-368)

A case is described of a 9 months old infant who died in shock with profuse gastrointestinal hemorrhage about 2 hours after ingesting 11 or 12 ferrous sulfate tablets. Serum iron concentration was 38,000 μg./100 ml. Prompt emptying of the stomach is considered to the first priority of treatment. The use of ipecac is favored over gastric lavage for inducing emesis.

241. **Medical progress in the prevention of childhood lead intoxication**—Greengard J., Zollar L. and Sharifi M., Dept. of Ped., Loma Linda Univ., Chicago, Ill.—ILLINOIS MED. J. 1968, 133/5 (615-618 and 650)

A case finding survey aimed at detecting children in the 1-5 year age group at risk from lead intoxication is described. Of 812 such children referred to the Cook County Hospital, Chicago, Ill., 288 or a little over one-third were considered to have body burdens of lead high enough to be benefited by therapy. Qualitative determination of coproporphyrin III in the urine as a screening test in case finding is extremely inefficient. A history of pica in such children residing in deteriorated housing in the lead belt is more rewarding. In the 8 year period immediately preceding the year of this neighborhood survey, 160 children were treated for lead encephalopathy with 61 deaths, a case fatality rate of 38.1%. During the survey year, there were 22 admissions for lead encephalopathy with 3 deaths, a fatality rate of 13.6%. 164 children were treated as outpatients with a daily intramuscular injection of calcium disodium edetate in a 5-day course. The risk of this procedure was recognized. No instance of aggravated lead intoxication in this group was documented. Some method of separation of such children from their source of lead is recommended.

242. **Deferoxamine in the treatment of acute iron poisoning. Clinical experiences with 172 children**—Westlin W.F., Res. Dept., CIBA Pharmaceut. Co., Summit, N.J.—CLIN. PEDIAT. (PHILAD.) 1966, 5 (531-535)

Deferoxamine is a potent specific iron-chelating agent whose use in treatment of acute iron poisoning in 172 patients is described. 2000 cases of acute iron poisoning occur in the US annually; 45% may be fatal. All the 172 patients except 1 were young children. In 36% the amount ingested was unknown; 50% had taken more than 3 g. Overall mortality was only 1.7%. Serum iron levels appeared to be of prognostic significance, in contradiction to results reported elsewhere. Incidence of shock or coma was greater with higher levels. Deferoxamine forms an adjunct to standard methods of treatment. When given orally, it will remove ingested iron from the gut but is only absorbed to a small extent, so intramuscular or intravenous administration is necessary to chelate absorbed iron. Intramuscular administration is preferable because it avoids the potential hazard of drug-induced hypotension; however where the patient is comatose or collapsed with severe poisoning deferoxamine should be given by slow intravenous administration. Details of dosage and administration techniques are given. Deferoxamine and the complex which it forms with iron are excreted almost entirely by the kidney, so treatment is contraindicated where renal function is impaired unless dialysis is used.

243. The treatment of poisonings - aggressive or conservative?—James J.A.—J. PEDIAT. 1970, 76/4 (651-652)

Should treatment of poisoning be aggressive or conservative? A good example for the answer to this question is given in the treatment of iron poisoning. When dogs are given a lethal dose of ferrous sulfate, an exchange transfusion with an infusion of deferoxamine, in most cases, proved effective. Can these data be extrapolated to the clinical situation of poisoned children? In infants the mortality rate of iron poisoning is small: in a recent series of 66 consecutive children admitted to the Los Angeles County-University of Southern California Medical Center there were no deaths. In 172 cases from several medical centers there were only 3 deaths (1.7%). Most of these patients received only deferoxamine with supportive therapy. The value of exchange transfusions will be most difficult to define in these circumstances in clinical medicine. Better means will be necessary for the early recognition of a child who has ingested a lethal or probably lethal dose of iron.

244. Clinical uses of metal-binding drugs—Chenoweth M.B., Biochem. Res. Lab., Dow Chem. Co., Midland, Mich.—CLIN. PHARMACOL. THER. 1968, 9/3 (365-387)

Arsenic and mercury poisonings call for immediate systematic treatment with dimercaprol; symptoms of chronic lead poisoning respond well to systemic calcium disodium edetate; Wilson's disease is ameliorated by oral d-penicillamine; and all the other situations discussed are still experimental and *sub judice*. Many of the observations reported on the effects of these drugs do not seem to be clearly related to metal binding. Certain toxic metals such as cadmium, thallium, beryllium, and manganese have as yet no notably effective antidotes.

245. The use of chelating agents in the treatment of acute and chronic lead intoxication in childhood—Chisolm Jr J.J., Dept. of Ped., Johns Hopkins Univ. Sch. of Med., Baltimore, Md.—J. PEDIAT. 1968, 73/1 (1-38)

The toxicologic studies reported here provide supportive evidence that prompt institution of chelation therapy with the combination of dimercaprol and CaEDTA together with appropriate supportive therapy can reduce substantially the mortality rate of acute encephalopathy in children with lead intoxication. Treatment of acute encephalopathy with EDTA alone is associated with a mortality rate of 25% or greater. The author reported no deaths in 24 cases of acute encephalopathy treated with dimercaprol and EDTA. Biochemical data also indicate that the dimercaprol-EDTA combination is superior to EDTA alone in the treatment of severe acute toxic episodes of plumbism. Evidence presented also suggests that long-term oral administration of d-penicillamine is safe and may be efficacious in the management of the chronic phase of lead poisoning. The rationale for the use of each of these 3 chelating agents is discussed.

246. Treatment of acute iron intoxication with deferoxamine: a report of six cases. Chelating agent proves effective in management of acute iron poisoning—Coli R.D., Leone L.A. and Albala M.M., Dept. of Oncol., Rhode Island Hosp., Providence, R.I.—R.I. MED. J. 1967, 56/8 (549-553, 578-579)

The iron chelating agent, deferoxamine, has given promising results in the treatment of acute iron poisoning in children. In 172 cases of various degrees of severity, it reduced the mortality to 1.7% (3 deaths). This is a report on 6 children who accidentally ingested toxic doses of ferrous sulfate. The first child took 6.0 g. and vomited repeatedly but was never severely ill and rapidly recovered after gastric lavage and 3 g. of deferoxamine methanesulfate orally with 1 g. intramuscularly. The second child became lethargic and incontinent after 5.9 g. His clinical course was that of acute iron poisoning, initial improvement being followed by a relapse ending in coma, convulsions and death. The third child took a much larger amount (19.5 g.) and had a higher serum-iron content than the child who died but recovered uneventfully. The management of acute iron intoxication includes gastric lavage, correction of acidosis and electrolyte abnormalities, and vigorous treatment of cardiovascular collapse. Chelating agents, of which deferoxamine is the most potent, are important adjuncts. Deferoxamine has a high affinity for plasma iron *in vitro*, but *in vivo* it removes only insignificant amounts of iron from transferrin and does not remove iron from the bone marrow or from hemoglobin. Given parenterally, it competes with transferrin for plasma iron and forms a complex with excess ferric ions, rendering them nontoxic. Chelating agents have strikingly reduced the mortality from iron poisoning, and deferoxamine has proved the most potent and specific and also the safest of them. After parenteral deferoxamine, the serum-iron levels return to normal or subnormal in 12-36 hours. This is a more rapid fall than is obtainable with EDTA, and deferoxamine does not increase the excretion of sodium, potassium, calcium, magnesium, or any of the important trace metals, such as copper and zinc. No toxic effects have been reported. Large oral doses may slightly aggravate the diarrhea by causing additional intestinal irritation, but this effect may be actually helpful in promoting the elimination of deferoxamine-bound iron. Rapid intravenous injections sometimes produce a rash, transient tachycardia and hypotension, and they should therefore be reserved for patients who are already in coma or shock. The initial dose of deferoxamine recommended for normotensive patients with suspected iron intoxication is 5-10 g., given after gastric lavage, followed by 1-2 g. intramuscularly every 12 hours for 1-2 days. Intramuscular injection seems to be an acceptable alternative to intravenous infusion, which has been used in most of the reported cases.

247. Treatment of lead encephalopathy in children—Coffin R., Phillips J.L., Staples W.I. and Spector S., Dept. of Ped., Western Reserve Univ. Sch. of Med., Cleveland, O.—J. PEDIAT. 1966, 69/2 (198-206)

A method for the treatment of severe lead encephalopathy using the combination of calcium EDTA and dimercaprol is presented. Twenty-two patients have been treated between 1954 and 1965 with only 1 death. The rationale for the use of this treatment is discussed, as well as measures intended to reduce cerebral edema.

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